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TESTS OF AN URBAN METEORLOGICAL-POLLUTANT MODEL USING CO VALIDATION DATA IN THE LOS ANGELES METROPOLITAN AREA. VOLUME II. FORTRAN PROGRAM AND INPUT/OUTPUT SPECIFICATION

Joseph P. Pandolfo, et al

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Tests of an Urban Meteorological-Pollutant Model Using CO Validation Data in the Los Angeles Metropolitan Area Volume II, Fortran Program and Input/Output Specification

by

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1.0 THREE-DIMENSIONAL BOUNDARY LAYER MODEL COMPUTER PROGRAMS

1.1 Vertical and Horizontal Grids

The vertical grid at each horizontal grid point is shown in Figure 1 below, with the notation used for the height indices. This grid is identical for each grid point in the horizontal array. A sample 5×5 horizontal grid is shown in Figure 2.

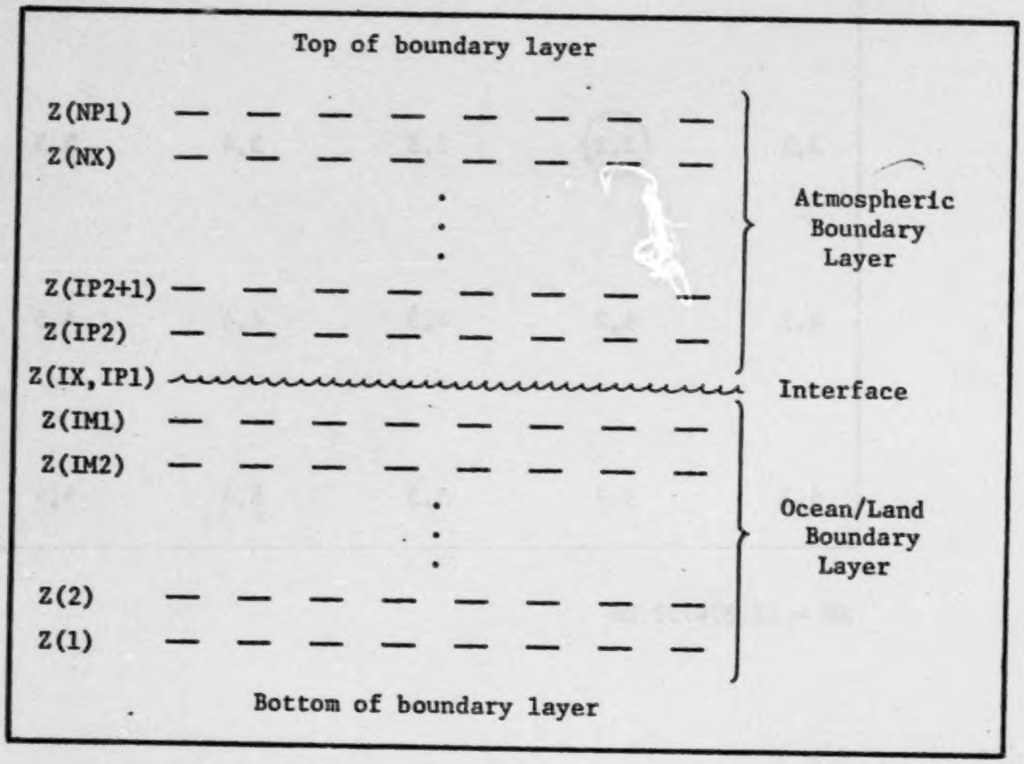


Figure 1. Notation Used in Height Indices. All height indices are referred to the bottom grid level in the ocean/land (Z(1) in the diagram above). There are two grid levels (Z(IX) = Z(IP1) = 0 cm) defined at the interface. Z(IX) = 0 is the water/land interface and Z(IP1) = 0 is the air interface.

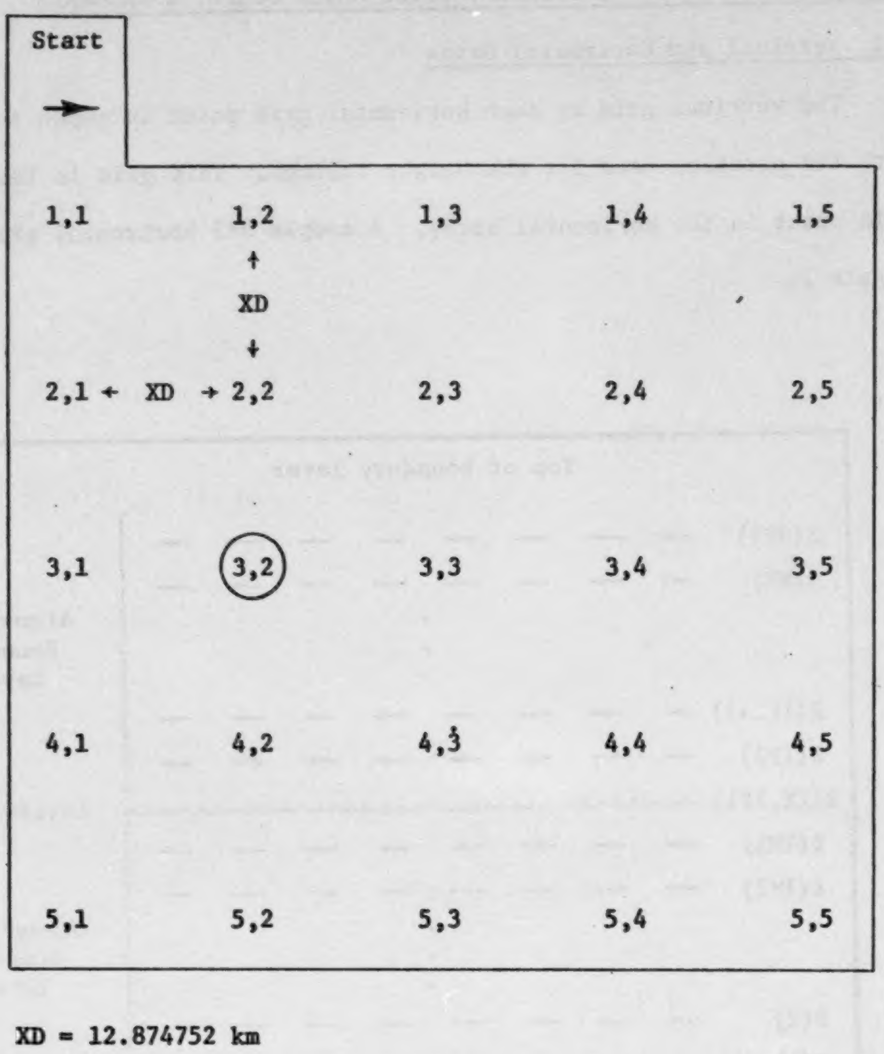


Figure 2. 5 × 5 Sample Horizontal Grid Network. The routine called TEMPRT can be optioned to printout any and/or all of the grid points in the grid areas. The circled point indicates the initial profiles input point which can be anywhere in the grid area and not necessarily at a given grid point.

1.2 Input Deck Setup

The input for each simulation is given by the following card sets. Units are given and the notation, n.d., implies nondimensional.

— — —

CARD TYPE (number ( ) of cards in set)

Type Number	Format	Columns	Program Symbols	Program Designates
1(1)	18A4	1-72	COM	Comment Card.
2(1)	14I5	1-5	NX	Number of levels in the boundary layer minus one (NX $\leq$ 29).
		6-10	IX	Height index at the interface (IX $\geq$ 4)(n.d.).
		11-15	NT	Number of time steps.
		16-20	IMAX	Number of horizontal grid points (x-direction).
		21-25	JMAX	Number of horizontal grid points (y-direction).
		26-30	NTIME	-1: No meteorological input as a function of time. 0: Meteorological input.*
		31-35	NVAR6	Not used.
		36-40	ITESTP	Interval time step for printout (n.d.).
		41-45	IPOL	Pollutants present (0,1,2) (n.d.).

The following card is only used when columns 26-30, Card 2, is 0.

Type Number	Format	Columns	Program Symbols	Program Designates
2M(1)	14I5	1-5	NVCHS(1)	+1: u and v wind and water current components are specified. 0: Not specified.

---

* This option has not been fully tested.

		9-10	NVCHS(2)	+1: Temperature and specific humidity are specified. 0: Not specified.
		14-15	NVCHS(3)	Not used.
		19-20	NVCHS(4)	+1: Interface temperature is specified.* 0: Not specified.
3(1)	6F12.4	1-12	DT	Time step (min).
		13-24	XD	Horizontal grid spacing (km).
		25-36	DECLX	Declination (deg).
		37-48	DCHG	Daily declination change (deg).
		49-60	XIIN	Input grid point (x-coordinate)(n.d.).
		61-72	XJIN	Input grid point (y-coordinate)(n.d.).
4(1)	6F12.4	1-12	PHIBOT	Latitude at southwestern grid point (deg).
		13-24	HWEST	Initial local hour angle at western grid boundary (deg).
		25-36	EM	Infrared emissivity of the surface (n.d.).
		37-48	ZW	Height of the vertical grid level to be used in the computation of the wave dimensions. This height is 19.5m or the lowest grid level above 19.5m (cm).
		49-60	RTIME	Time step for radiation computation (min).
5(N/6)	6F12.4	1-12 ⋮ 61-72	Z_j(j=1,N)	Distance of the vertical grid levels from the interface in centimeters ($N \leq 30$). Values below interface indicated by minus.

---

* Not completed.

Cards 6-11 assume the initial values to be at the horizontal grid point, XIIN, XJIN given on Card 3.

6(N/6)	6F12.4	1-12 ⋮ 61-72	$U_j (j=1,N)$	Initial values of eastward wind or current component (cm/sec). Values of U(IX) and U(IP1) must be equal.
7(N/6)	6F12.4	1-12 ⋮ 61-72	$V_j (j=1,N)$	Initial values of northward wind or current component (cm/sec). Values of V(IX) and V(IP1) must be equal.
8(N/6)	6F12.4	1-12 ⋮ 61-72	$T_j (j=1,N)$	Initial values of the atmospheric and oceanic temperatures (°K). Values of T(IX) and T(IP1) must be equal.
9(N/6)	6F12.4	1-12 ⋮ 61-72	$W_j (j=1,N)$	Initial values of oceanic salinity (g/kg), N=1, IX; and values of atmospheric humidity (g/kg), N=IP1, NP1. In most cases, W(IX) and W(IP1) will not have numerically equal values.
10(N/6)	6F12.4	1-12 ⋮ 61-72	$PP12_j (j=1,N)$	Initial values of pollutant 1 ($\mu g/m^3$). Values from 1 to IP1 are not used.
11(N/6)	6F12.4	1-12 ⋮ 61-72	$PP22_j (j=1,N)$	Initial values of pollutant 2 ($\mu g/m^3$). Values from 1 to IP1 are not used.

Cards 12-15 are information relating to the initial and peripheral horizontal gradients. The card set consisting of Cards 12-15 are repeated for each of the following parameters in the order in which they appear:

j = 1	Oceanic and atmospheric - u-gradients (cm/sec/cm)
2	Oceanic and atmospheric - v-gradients (cm/sec/cm)
3	Oceanic and atmospheric temperature gradients (°K/cm)
4	Oceanic salinity and atmospheric humidity gradients (g/kg/cm)
5	Pollutant 1 gradients ($\mu g/m^3/cm$)
6	Pollutant 2 gradients ($\mu g/m^3/cm$).

NOTE: The horizontal gradients at the interface should be repeated if the subsurface and the atmospheric horizontal gradients are different at the interface. Whenever there is only one input level, the horizontal gradient is assumed to be constant at all height levels.

12(1)	14I5	1-5	K_j	Number of grid levels at which gradients are input for appropriate parameter where j on cards 12,13,14, 15 is defined on bottom of previous page ($K \leq 30$).
13(N/6)	6E12.5	1-12 ⋮ 61-72	ZI(i) $(i=1,K_j)$	Height (cm) of input horizontal gradient levels in ascending order. A minus sign indicates values below the interface.
14(N/6)	6E12.5	1-12 ⋮ 61-72	ZDIX(i) $(i=1,K_j)$	x-horizontal gradients in ascending order. Units are defined above.
15(N/6)	6E12.5	1-12 ⋮ 61-72	ZDIY(i) $(i=1,K_j)$	y-horizontal gradients in ascending order. Units are defined above.
16(1)	4F10.2	1-10	S0AB	Solar absorption coefficient (km^{-1}).
		11-20	S0SC	Solar backscatter coefficient (km^{-1}).
		21-30	XN0	Infrared absorption coefficient (km^{-1}).
		31-40	C0C0B	Mie initialization factor (g air/10^{10}g pollutant). A constant that depends on the density and specific volume of an aerosol distribution.
17(1)	14I5	1-5	NLAP	Number of levels above NP1 in the atmospheric sounding for input (n.d.) (≤ 20).
		6-10	NPU	Indicator of the reference level for pressure computations (see input card type 20)(0,1).

NOTE: Cards are repeated NLAP times.

18(NLAP)	4F10.2	1-10	PA	Pressure (mb).
		11-20	TA	Temperature (°K).
		21-30	QA	Humidity (g/kg).
		31-40	CØB	0.

The first set of cards, 30M to 33M, are input here only when columns 26 to 30, Card 2, is 0 (see Card 30M). The following cards (19-28) are repeated for each horizontal grid point in the order 1,1; 1,2; ... 2,1 ... as indicated in Figure 2.

19(1)	14I5	1-5	NTFØR	Number of cloud input cards (n.d.)($\leq$ 10).
		6-10	NCL	Number of cloud layers (n.d.)($\leq$ 4).
		11-15	NTCUV	Number of geostrophic wind current component input cards (n.d.)($\leq$ 20).
		16-20	IPØI	Number of pollutants source types at this grid point (n.d.)(0,1,2).
		21-25	IGØNY	Water/land option indicator (-2 = coastal corner, -1 = coastal, 0 = water, 1 = land.
		26-30	ISSI1	Number of input time steps used for pollutant 1 (n.d.) (if IPØI=1,2)($\leq$ 20).
		31-35	ISSI2	Number of input time steps used for pollutant 2 (n.d.) (if IPØI=2)($\leq$ 20).
20(1)	4F10.2	1-10	PSFA	Pressure at surface (mb) NPU=0; or pressure at upper boundary (mb) NPU=1.
		11-20	XLAM	Wavelength of the characteristic turbulent wave ($-Z_0$ if land)(cm).
		21-30	DEL	Steepness of the characteristic turbulent wave (0 if land)(n.d.).

20a(1)	6E12.4	1-12	SLOPX	Slope of the land surface at the interface in the x-direction.
		13-24	SLOPY	Slope of the land surface at the interface in the y-direction.
		25-36	HEIGHT	Height of land or depth of water from an absolute reference surface (e.g., mean sea level) land elevation positive, water depth negative (m).
		37-48	ETAINX	Elevation of water surface at open boundaries (N-S boundaries, cm).
		49-60	ETAINY	Elevation of water surface at open boundaries (E-W boundaries, cm).
		61-72	IANV	See below.

IANV = 0 For coastal corner (IGONY = -2)
For water (IGONY = 0)
For land (IGONY = +1)
= 1 For a coastal station (IGONY = -1) which lies parallel to the latitude (EAST-WEST DIRECTED).
= 2 For a coastal station (IGONY = -1) which lies perpendicular to the latitude (NORTH-SOUTH DIRECTED).

NOTE: In the following card set, linear interpolation in time is used to compute the geostrophic winds and currents at each time step from the input values. When only one value is input, the values are assumed constant.

21(NTCUV) (I5,4F10.2,2A4)

1-5	ICUV	Input time step for geostrophic wind current (n.d.).
6-15	XOCU	Eastward component of geostrophic current at Z(IX) (cm/sec).
16-25	XOCV	Northward component of geostrophic current at Z(IX)(cm/sec).
26-35	XACU	Eastward component of geostrophic wind at Z(NP1) (cm/sec).

	36-45	XACV	Northward component of geostrophic wind at Z(NP1) (cm/sec).
	46-53	T1,T2	Not used in program. Used to identify station in deck and printout.

NOTE: The following card set is included only when NCL on Card 19 is not equal to zero. Linear interpolation is used to compute the cloud amounts at each level and the rainfall rate at each time step from the clouds and rainfall rate specified at the input time steps. When only one time step is input, the values are held constant.

22(NTFØR)	[I4,I2,F6.2,5(I3,F4.1,F4.0)]		
	1-4	ISTEP	Input time step for clouds (n.d.)(≤ 10).
	5-6	NXN	Number of cloud layers (n.d.)(≤ 4).
	7-12	RAINI	Rainfall rate (cm/sec).
	13-15	LLCI	Index for the grid level at which cloud layer occurs.
	16-20	ECLI	Cloud amount at level (tenths).
	21-24	TCLI	Cloud type at level (1, ... 9).*

Repeated for NXN levels as needed.

25-27	LLCI	Level 2
28-32	ECLI	Amount 2
33-36	TCLI	Type 2
37-39	LLCI	Level 3
40-44	ECLI	Amount 3
45-48	TCLI	Type 3
49-51	LLCI	Level 4
52-56	ECLI	Amount 4
57-60	TCLI	Type 4.

---

*Cloud type is defined as

1) Fog
2) Stratus
3) Strato Cumulus
4) Cumulus
5) Cumulonimbus
6) Alto Stratus
7) Alto Cumulus
8) Cirrus
9) Cirro Stratus

NOTE: Include Cards 23 and 24 only when IGØNY on Card 19 is 1 (i.e. land).

23(1)	7F10.2	1-10	SRS	Surface albedo (n.d.) $(0 \leq r \leq 1)$.
		11-20	RØW	Surface density (g/cm^3) (n.d.).
		21-30	CW	Surface specific heat (n.d.) (cal/cm/sec).
		31-40	XMQ	Moisture parameter (n.d.) $(0 \leq m \leq 1)$.
		41-50	RADMX	Artificial heat source due to combustion by man (n.d.).
24(1)	7F10.2	1-10	XKT$_i$(i=1,IM1)	Thermal diffusivity for soil layers (cm^2/sec).

Cards 25 to 27 are included only when IPØI on Card 19 is 1 or 2. When IPØI is 2, the set is repeated for the second pollutant source.

NOTE: Linear interpolation in time is used to compute the pollutant source at each time step from input values identified on the following cards (25 and 26). If one value is used, the value is constant.

25(1)	14I5	1-5 ⋮ 65-70	ITS1	Time step for input pollutant source (n.d.). There are ISSI1 (Card 19) values in the first set and ISSI2 in the second set, if IPØ1=2.
26(1)	7F10.2	1-10 ⋮ 61-70	SØU1	Strength of pollutant source emissions (µg/m^2/sec) for pollutant 1 in the first set and pollutant 2 if the second set is used.
27(1)	6F10.2	1-10 ⋮ 51-60	SH1(1-6)	Fractional source emission at each height level from the interface to the 5th atmospheric level for pollutant 1 (2 if second set) (n.d.).

NOTE: Include Card 28 only when IGØNY = 1 (i.e. land).

28(1)	6F12.4	1-12 ⋮ 61-72	YY(I,3)	Temperatures in the soil at each level (1 to IP1).
29(1)	6E12.4	1-12	YY(I,5)	Pollutants for individual stations (I = IX,NP1). See IPØL (Card type 2). 0: none read. 1: set (1) read YY(I,5). 2: set (2) read YY(I,6).

The following are included only when columns 26-30, Card 2 is 0, and the card set 30-33 repeated for each input time step; i.e., specified meteorological variables are input at all time steps. The first card set, 30M to 33M will be input after Card 18. All other sets follow Card 29.

30M(1)	14I5	1-5	NTIME	Time step for input variable.
		10	K	Number of input gradient levels for each.

The following cards are repeated for each level i = 1,NP1 . Only the input variables need be specified.

31M(1)	7F10.2	1-10	VARIN(i,1)	Input value at NTIME for u-component (cm/sec).
		11-20	VARIN(i,2)	Input value at NTIME for v-component (cm/sec).
		21-30	VARIN(i,3)	Input value at NTIME for temperature (°K).
		31-40	VARIN(i,4)	Input value at NTIME for specific humidity (g/kg).

The following set of 2 cards each are read for each level that there is a gradient. There are "K" sets of cards. Include Card 1 when NVCHS(1) = 1 (see Card 2M).

32M(1)	7F10.2	1-10	Height of gradient (cm).
		11-20	u-gradient in x-direction.
		21-30	u-gradient in y-direction.
		31-40	v-gradient in x-direction.
		41-50	v-gradient in y-direction.

Include following in each set when NVCHS(2) = 1 . See card 2M.

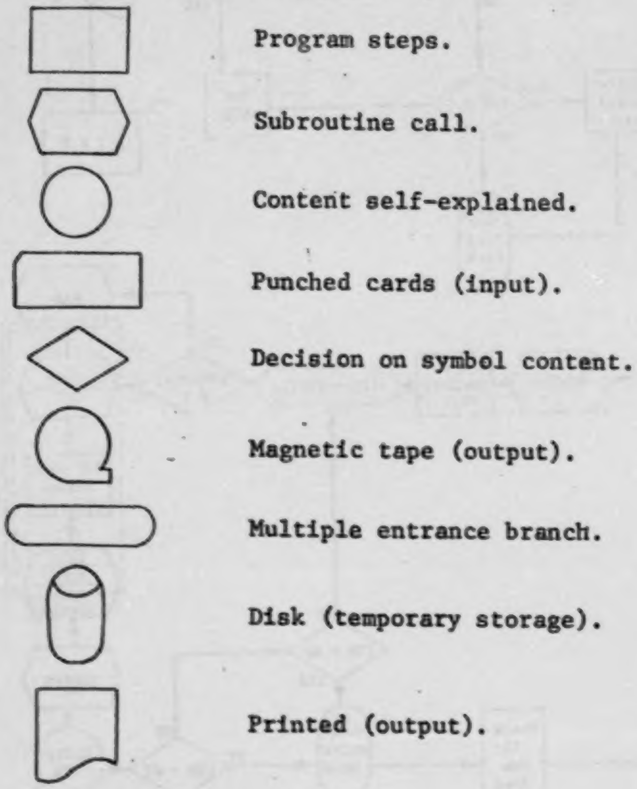
33M(1)	7F10.2	1-10	Height gradient (cm).
		11-20	Temperature gradient in the x-direction.
		21-30	Temperature gradient in the y-direction.
		31-40	Specific humidity gradient in the x-direction.
		41-50	Specific humidity gradient in the y-direction.

The set of cards (30M - 33M) is repeated at each input time step until the time step on 30M (NTIME) is greater or equal to the last time step of the simulation (NT on Card 2).

2.0 MAIN PROGRAM: RIGID LID Version

This section contains a flow diagram (Figure 3) which shows the operations in the numerical model MAIN Program, RIGID LID version, for the atmosphere-ocean planetary boundary layer with land option and pollutants. Following the flow diagram is its accompanying program listing.

The symbols used in the diagram are, for the most part, those which have become standard flow chart symbols. The explanation of the symbols is as follows:



Program steps.

Subroutine call.

Content self-explained.

Punched cards (input).

Decision on symbol content.

Magnetic tape (output).

Multiple entrance branch.

Disk (temporary storage).

Printed (output).

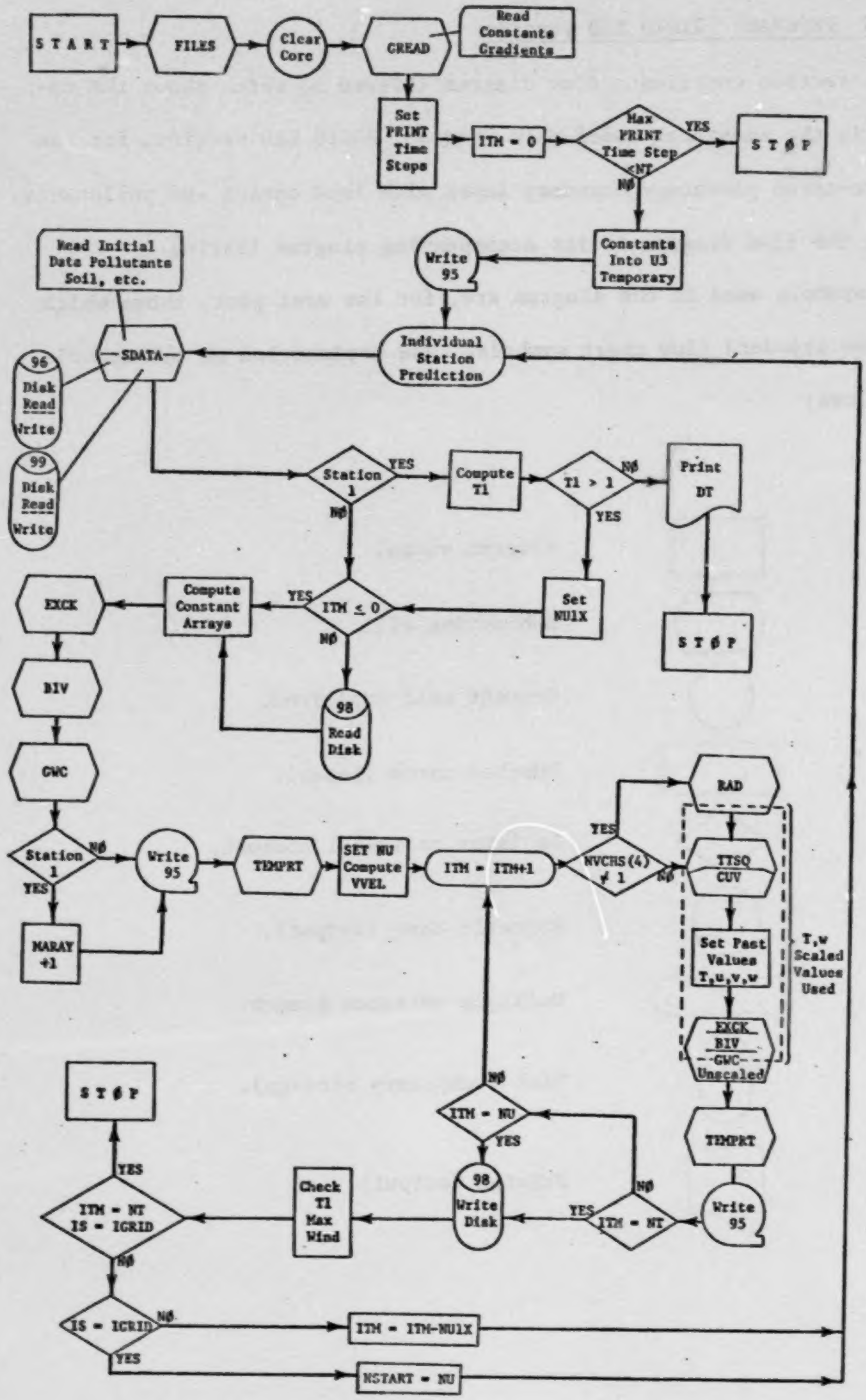


Figure 3. Flow Diagram MAIN Program, RIGID LID Version: Air-sea-land interaction model.

RIGID LID Program Listing

```
C       MAIN PROGRAM AIR-SEA INTERACTION  WITH  LAND OPTION                MAIN000
C  1972 VERSION      TAPE OUTPUT  AT YOU GO                                MAIN001
      INTEGER RDRUM,SDRUM,TDRUM                                            MAIN002
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO DST,DT1,FA,GWO,PP11,PQ12        MAIN003
     1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3      MAIN004
     2    ,WO,WSC,XKT,XYY,YY,GTO                                           MAIN005
COMMON-DOUBLE PRECISION NOT ON DISK OR RESTART                             MAIN006
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)           MAIN007
     1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)        MAIN008
     2    ,TT3(30),W3(30),SST                                              MAIN009
COMMON-FOR PRINT ONLY                                                      MAIN010
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,   MAIN011
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE   MAIN012
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2                MAIN013
COMMON-FOR RESTART AND PRINTOUT                                            MAIN014
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                  MAIN015
     1    ,XLAM,RSUM(15),B1,B2                                             MAIN016
COMMON-NEEDED FOR RESTART ONLY                                             MAIN017
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)       MAIN018
     1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)    MAIN019
     2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2     MAIN020
     3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)    MAIN021
     4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)          MAIN022
     5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF                MAIN023
     6    ,PHIR,GD2,ISTR,SOSC,SCAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV           MAIN024
COMMON-OTHER THAN DOUBLE PRECISION-PRINT OR RESTART                        MAIN025
     7   ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)  MAIN026
      COMMON U3(30),V3(30),TBC(30),WBO(30),CKO(30),CSW(30),PSS(30)         MAIN027
     1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)      MAIN028
     2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)   MAIN029
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                         MAIN030
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6      MAIN031
     1   ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3       MAIN032
     2   ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME    MAIN033
     3   ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2      MAIN034
     4   ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2             MAIN035
     5   ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                    MAIN036
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL        MAIN037
     1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                       MAIN038
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20       MAIN039
     2    ,  T13,T14,T15,T16,XD1,YD1                                       MAIN040
     3   ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                          MAIN041
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II    MAIN042
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)        MAIN043
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                           MAIN044
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)             MAIN045
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))        MAIN046
     1   ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))               MAIN047
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                         MAIN048
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                         MAIN049
      COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)                  MAIN050
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)        MAIN051
     1   ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)                 MAIN052
     2   ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)                 MAIN053
     3   ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)                MAIN054
     4  ,CP2X(30),CP2Y(30)
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))
C   UNITS 99,96 FOR YY TO STORE FOR COMPUTATION OF GRADIENTS--DIRECT ACC
C   UNIT  98  FOR RESTART VARIABLES -- DIRECT ACCESS
C   UNIT  95  STORAGE FILE FOR PRINT -- TAPE OR DISK SEQUENTIAL
      DOUBLE PRECISION XT1,XTIME
      DIMENSION ZEROCM(2)    ,YIN(1)
      EQUIVALENCE (ZEROCM(1),XYY(1,1,1))   , (U2(1),YIN(1))
      DO 555 I=1,6167
  555 ZEROCM(I) = 0.
      CALL FILES
      SDRUM = 99
      RDRUM = 96
      NWSYY = 180*2 + 12
C    TIMES 2 FOR DOUBLE PRECISION ONLY
      IXTRA = 1
      NCR = 1358
      NCS =  594
      TDEL = 0.
      IK = 0
C     COMPUTE GRADIENTS   AND READ IN DATA FOR THE GRID
      CALL GREAD
      I = 0
      DO 702 J=1,20
      ITIMES(J) = I
  702 I = I+ITESTP
      ITM = 0
      IF (ITIMES(20).LT.NT) GO TO 80
      NSTART = 0
C     INDIVIDUAL STATION PREDICTION FILE 1
      XDT1 = XD/110.8 * 1.E-5
      SAVE = 0.01
      U3(1) = NCS
      U3(2) = JMAX
      U3(3)= IMAX
      U3(4) = IPOL+11
      U3(5) = NP1
      U3(6) = IX
      U3(7) = DT
      DO 703 I=1,20
  703 U3(I+7) = ITIMES(I)
      U3(28) = XD * 1.E-5
      WRITE (95    ) (Z(I),I=1,NCS)
```

```
   41 DO 98 NS=1,JMAX
      DO 98 MS=1,IMAX
      IS = (NS-1) * IMAX + MS
      CALL SDATA
      IF (IS.GT.1) GO TO 90
      T1 = TDEL /(1.424214*DT)
      PRINT 335,ITM,DT,T1
      IF (T1-1.)1112,1112,336
 1112 PRINT 31
      GO TO 80
  336 NU1X = T1
      IF(ITM+NU1X.GT.NT)NU1X = NT-ITM
      IF(NTIME.GT.0.AND.ITM+NU1X.GT.NTIME)NU1X = NTIME-ITM
      NUX = NSTART + NU1X
   90 IF(ITM.LE.0) GO TO 47
C     READ FILE 1 FOR RESTART
      READ (98'IS) (XKU(I),I=1,NCR)
      IGONY = IGOGO-3
   47 IF (NTIME.LT.0.OR.IGET.NE.ITM) GO TO 319
      XM = MS
      YM = NS
      XD1 = XD*(XIIN-XM)
      YD1 =-XD*(XJIN-YM)
      XT1= NTIME-IGET
      XTIME = 1./XT1
      DO 315 I=1,NP1
      IF (NVCHS(1).NE.1)  GO TO 312
C   COMPUTE NEW INPUT U3,V3
      U3(I)  = VARIN(I,1)-GNV(I,2)*YD1-GNV(I,1)*XD1
      V3(I)  = VARIN(I,2)-GNV(I,4)*YD1-GNV(I,3)*XD1
      U1(I) = U2(I)-XTIME*(U3(I)-U2(I))
      V1(I) = V2(I)-XTIME*(V3(I)-V2(I))
  312 IF (NVCHS(2).NE.1) GO TO 315
      TT3(I) = VARIN(I,3)-GNV(I,6)*YD1-GNV(I,5)*XD1-TTO(I)
      W3 (I) = VARIN(I,4)-GNV(I,8)*YD1-GNV(I,7)*XD1-WO(I)
      TT1(I)= TT2(I)-XTIME*(TT3(I)-TT2(I))
      W1 (I)= W2 (I)-XTIME*(W3 (I)-W2(I))
  315 CONTINUE
  319 DO 2000 I=1,NX
      DTO(I)=TTO(I+1)-TTO(I)
      TBO(I)=(TTO(I+1)+TTO(I))/2.
      WBO(I)=(WO(I+1)+WO(I))/2.
      IF(I-IX)88,2000,88
   88 DWO(I) = WO(I+1)-WO(I)
      GTO(I)=DTO(I)/DZ(I)
      GWO(I)=DWO(I)/DZ(I)
 2000 CONTINUE
      H3 = 0.
C     INEWC = INEW
      IRAT = IMARA
      IF(ITM.GE.1) GO TO 49
      I1IHT = 2
      I2IHT= 2
      I3IHT = 2
      I4IHT= 2
   35 CALL EXCK
      H = H * .017453293
      RSUM(15) = XKT(NX)
      RSUM(14) = XKT(1)
   40 CALL BIV
   45 CALL GWC
C     STORE INITIAL TIME STEP DATA FOR ALL STATIONS FOR PRINT FILE 3
      IF (IS.GT.1) GO TO 46
      MARAY(IXTRA) = MARAY(IXTRA)+1
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)
   46 WRITE (95) (RI(I),I=1,NCS)
      CALL TEMPRT
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO
   49 NU = NUX
  857 IF(IGONY.GT.0) GO TO 202
      IF(IHT.GT.1) GO TO 201
      SUM2 = (CUX(IX)+CVY(IX))*(DZ(IM1)/2.)
      DO 209 I=2,IX
      K=IX-I+1
      SUM2 = SUM2 + (CUX(K)+CVY(K))*(DZ(K-1)+DZ(K))/2.
  209 VVEL(K) = SUM2
      VVEL(IX)=0.
      IF(ITM.GT.1) GO TO 202
      ETA2 = 0.
      DELZ = 0.
      SLOPX= 0.
      SLOPY= 0.
      GO TO 202
  201 DO 267 I=1,IX
  267 VVEL(I) = 0.0
      SUM1 = 0.
      IIHT = IHT
      IF(IGONY.EQ.-2) IIHT = 2
      DO 200 K=IIHT,IM1
      SUM1 = SUM1 - (CUX(K) + CVY(K))*(DZ(K-1) + DZ(K))/2.
      VVEL(K) = SUM1
  200 CONTINUE
      VVEL(IX) = SUM1 - (CUX(IX) + CVY(IX))*(DZ(IM1)/2.)
      VVEL(IP1) = VVEL(IX)
      ETA2 = ETA1 + VVEL(IX)*DT
      DELZ = ETA2 - ETA1
      IF(ABS(ETA2).GT.500..AND .IGOGO.NE.1) GO TO 206
      GO TO 205
  206 PRINT 207,ETA2                        ,DELZ,VVEL(IX),ITM,IS,IGOGO
  207 FORMAT(1X,'THE WATER SURFACE ELEVATION ETA2 IS',F12.3,/
     1' DELZ = ',F12.3
    2/' VVEL(IX) = ',F12.3/' ITM = ',I10/' IS = ',I10/' IGOGO = ',I10)
      GO TO 99
  205 SUM1 = VVEL(IP1)
      DO 208 I=IP2,NP1
      SUM1 = SUM1 - (CUX(I) + CVY(I))*(DZ(I-1) + DZ(I))/2.
      VVEL(I) = SUM1
  208 CONTINUE
      VVEL(NX) = SUM1 - (CUX(NX) + CVY(NX))*(DZ(NP1)/2.)
      GO TO 50
```

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202 VVEL(IP1) = 0.0
    VVEL(IP2) =                                  - (CUX(IP2)+ CVY(IP2))*
   1((DZ(IP1) + DZ(IP2))/2.)
    SUM1 = VVEL(IP2)
    DO 203 K=IP3,NP1
    SUM1 = SUM1 - (CUX(K) + CVY(K))*((DZ(K-1) + DZ(K))/2.)
    VVEL(K) = SUM1
203 CONTINUE
    VVEL(NX) = SUM1 - (CUX(NX)+ CVY(NX))*(DZ(NP1)/2.)
 50 ITM=ITM+1
    IF(IGONY.EQ.1) DELZ=0.0
    IF(NVCHS(4).NE.1) CALL RAD
    CALL TTSQ
    IF (NTIME.LT.0) GO TO 117
    DO 116I=1,NP1
    IF (NVCHS(1).NE.1) GO TO 114
    U3(I) = 2.*U2(I) - U1(I)
    V3(I) = 2.*V2(I) - V1(I)
114 IF(NVCHS(2).NE.1)GO TO 116
    W3(I) =  2.*W2(I)-W1(I)
    TT3(I) = 2.*TT2(I)-TT1(I)
116 CONTINUE
    IF (NVCHS(1).EQ.1)  GO TO 52
117 GO TO (112,111,111,112),IGOGO
111 I1 = 1
    II=2
    IT=IM2
    I2=IM3
    I3=IM1
129 I5 = IT -   IHT + 1
    IF(  IHT.GT.2) GO TO 131
    I5 = IM3
    I1 = 1
    II = 2
131 CALL CUV
    IF(IGONY.EQ.0) GO TO 121
113 IF(IANV.GT.1) GO TO 118
    DO 119 I=IHT,IX
    V3(I) = 0.0
119 CONTINUE
    GO TO 112
118 DO 120 I=IHT,IX
    U3(I) = 0.0
120 CONTINUE
    GO TO 112
121 IF(IHT.EQ.1) GO TO 112
    IF(I2IHT.LE.IHT) GO TO 123
    IIHT = I2IHT-1
    DO 124 I= IHT, IIHT
124 U3(I) = 0.0
123 IF(I3IHT.LE.IHT)GO TO 112
    IIHT = I3IHT-1
    DO 125 I= IHT, IIHT
125 V3(I)= 0.0
112 I1 = IP1
```

```
      I1=IP2
      IT=NM1
      I2=NM2
      I3=NX
      I5=IA
      CALL CUV
      GO TO (51,52),LY
   51 DTA = 2.*DTA
      DTA2 = 2.*DTA2
      C5 = 1.5
      C6 = 2.
      GD2 = .5
      LY=2
   52 CONTINUE
      DO 54 I=1,NP1
      TT1(I) = TT2(I)
      U1(I) = U2(I)
      V1(I) = V2(I)
      W1(I) = W2(I)
      TT2(I) = TT3(I)
      U2(I) = U3(I)
      V2(I) = V3(I)
      W2(I) = W3(I)
      PP11(I) = PP12(I)
      PP21(I) = PP22(I)
      PP12(I) = PP13(I)
      PP22(I) = PP23(I)
   54 CONTINUE
      ETA1 = ETA2
      IF(NVCHS(4).EQ.1) XT2 = TT3(IX)
      TT2(IX) = XT2
      TT2(IP1) = XT2
      CALL EXCK
      CALL BIV
      CALL GWC
   65 IF(ITM-ICK)94,70,70
   70 ICK = ICK+ ITESTP
      RSUM(14) = XKT(1)
      RSUM(15) = XKT(NX)
      IF (IS.GT.1) GO TO 701
      MARAY(IXTRA) = MARAY(IXTRA)+1
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)
  701 CALL TEMPRT
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO
  101 FORMAT(//'  ETA2 =',E18.8,/'  DELZ =',E18.8,/'  XETA2 =',E18.8,/'
     1 YETA2 =',E18.8,/'  CU(IX) =',E18.8,/'  CV(IX) =',E18.8,/'  IHT ='
     2,I10,/'  IGOGO =',I10)
      WRITE (95) (RI(I),I=1,NCS)
   94 IF(ITM.EQ.NT) GO TO 97
      IF(ITM.NE.NU) GO TO 50
C     STORING COMPUTED VALUES ON DRUM FOR RESTART OF EACH GRID STATION A
      WRITE (98'IS) (XKU(I),I=1,NCR)
      DO 59 I=1,NP1
      T1 = U2(I)**2+V2(I)**2
      IF (T1) 59,59,159
  159 T1 = SQRT(T1)
      IF (T1.GT.SAVE)  SAVE = T1
   59 CONTINUE
      TDEL = XD/SAVE
C   WRITE YY ON DISK USING DIRECT ACCESS
      IGOG = IGOGO
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)
   97 IF(ITM.EQ.NT.AND.IS.EQ.IGRID) GO TO 80
      IF(IS.EQ.IGRID) GO TO 98
      ITM = ITM - NU1X
   98 CONTINUE
C   SWITCH FILE UNITS FOR RESTART
      I = RDRUM
      RDRUM = SDRUM
      SDRUM = I
      IF(MARAY(IXTRA).NE.0) IXTRA = IXTRA + 1
      NSTART = NU
      GO TO 41
   80 PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)
      END FILE 95
      REWIND 95
   99 STOP
   31 FORMAT ('1RUN STOPPED--NEW DT NEEDED')
  132 FORMAT ('1TIME STEP STARTING = ',I5,' VALUES IN MARAY =',I5/' MARA
     1Y IS',20I4)
  335 FORMAT (' ITM',I6,'DT',E12.4,'T1',E12.4)
      END
```

```
 SUBROUTINE GREAD
 INTEGER RDRUM,SDRUM,TDRUM
 DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
2    ,WO,WSC,XKT,XYY,YY,GTO
 COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
2    ,TT3(30),W3(30),SST
 COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
 COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
1    ,XLAM,RSUM(15),B1,B2
 COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
6    ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
7   ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
 COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
 COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
 COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
1   ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
2   ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
3   ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
4   ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
5   ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
 COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
 COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
2     ,  T13,T14,T15,T16,XD1,YD1
3   ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
 COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
 COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
1 , I1IHT,I2IHT,I3IHT,I4IHT
 DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
 EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
1   ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
 COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99
 COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)
 COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)
 DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)
1   ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)
2   ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)
3   ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)
4   ,CP2X(30),CP2Y(30)
 EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))
 EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))
 EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))
 EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))
 EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))
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      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))             GREAD055
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))             GREAD056
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))             GREAD057
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))             GREAD058
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))             GREAD059
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))             GREAD060
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))             GREAD061
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))             GREAD062
      DIMENSION ZI(30),ZDIX(30),ZDIY(30),ARPRT(18)                      GREAD063
      EQUIVALENCE (A(1),ZI(1)),(B(1),ZDIX(1)),(C(1),ZDIY(1))            GREAD064
      DATA ARPRT /4HU CO,4HMPON,4HENT ,4HV CO,4HMPOM,4HENT ,4HTEMP,4HERAGREAD065
     1T ,4HURE ,   4HSALI,4HN./H,4HUMID,4HPOLL,4HUTAN,4HT 1 ,4HPOLL,4HUTGREAD066
     2AN,4HT 2 /                                                        GREAD067
      READ 100, (COM(I),I=1,18)                                         GREAD068
      PRINT 101,(COM(I),I=1,18)                                         GREAD069
      ROA = .001                                                        GREAD070
      READ 110, NX,IX,NT,IMAX,JMAX,NTIME,NVAR6,ITESTP,IPOL              GREAD071
      DO 2I=1,5                                                         GREAD072
    2 NVCHS(I) = 0                                                      GREAD073
      IF(NTIME.GE.0)READ110,(NVCHS(I),I=1,5)                            GREAD074
      IGRID = JMAX * IMAX                                               GREAD075
      PRINT 111, NX,IX,NT,IGRID                                         GREAD076
C     IGRID IS THE NUMBER OF STATIONS IN THIS MODEL GRID NETWORK        GREAD077
      READ 119,DT,XD,DECLX,DCHG,XIIN,XJIN                               GREAD078
      DECL = DECLX* .017453293                                          GREAD079
      DCHG = DCHG * .017453293                                          GREAD080
      READ 119,PHIBOT,HWEST,EM,ZW,RTIME                                 GREAD081
      H = HWEST * .017453293                                            GREAD082
    3 PRINT 112, XIIN,XJIN,PHIBOT,DT,XD                                 GREAD083
      DT = DT*60.                                                       GREAD084
      PRINT 1212, RTIME                                                 GREAD085
      IF(RTIME.LE.0.) RTIME = DT/60.                                    GREAD086
  700 IMARA = RTIME/DT*60.  +.5                                         GREAD087
      XD = XD * 1.E5                                                    GREAD088
      NP1=NX+1                                                          GREAD089
      IS = 0                                                            GREAD090
      IP1 = IX+1                                                        GREAD091
C     INITIAL STATION DATA INPUT   Z, T, U, V, W                        GREAD092
      READ 119,(Z(I),I=1,NP1)                                           GREAD093
      DO 6 J=1,6                                                        GREAD094
      READ 119, (YY(I,J),I=1,NP1)                                       GREAD095
    6 CONTINUE                                                          GREAD096
      DO 230 I=5,6                                                      GREAD097
      DO 230 N=1,NP1                                                    GREAD098
  230 YY(N,I) = YY(N,I) / ROA / 100.                                    GREAD099
C     COMPUTE PERIPHERAL GRADIENTS                                      GREAD100
      DO 420  K=1,6                                                     GREAD101
      READ 110,IZ1                                                      GREAD102
      READ 120, (ZI(I),I=1,IZ1)                                         GREAD103
      READ 120, (ZDIX(I),I=1,IZ1)                                       GREAD104
      READ 120, (ZDIY(I),I=1,IZ1)                                       GREAD105
      K2 = 3*K                                                          GREAD106
      K1 = K2-2                                                         GREAD107
      PRINT 123, (ARPRT(I),I=K1,K2),(ZI(I),I=1,IZ1)                     GREAD108
      PRINT 121, (ZDIX(I),I=1,IZ1)                                      GREAD109
      PRINT 122, (ZDIY(I),I=1,IZ1)                                      GREAD110
      DO 418 I=1,NP1                                                    GREAD111
      T1 = Z(I)                                                         GREAD112
      IF (I-IX) 417,416,417                                             GREAD113
  416 T1 = T1-.00001                                                    GREAD114
      GO TO 1418                                                        GREAD115
  417 IF (I-IP1) 1418,2418,1418                                         GREAD116
 2418 T1 = T1+.00001                                                    GREAD117
 1418 CALL XINEAR (T1,ZI,2,IZ1,L,ZDIX,GXY(I,K),ZDIY,GXY(I,K+6)          GREAD118
     1  ,T4,T4,T4,T4)                                                   GREAD119
      IF(K.LE.4) GO TO 231                                              GREAD120
      GXY(I,K) = GXY(I,K) / ROA / 100.                                  GREAD121
      GXY(I,K+6) = GXY(I,K+6) / ROA / 100.                              GREAD122
  231 PGXY(I,K) = GXY(I,K)                                              GREAD123
      CGXY(I,K) = GXY(I,K)                                              GREAD124
      PGXY(I,K+6) = GXY(I,K+6)                                          GREAD125
      CGXY(I,K+6) = GXY(I,K+6)                                          GREAD126
  418 CONTINUE                                                          GREAD127
  420 CONTINUE                                                          GREAD128
      READ 119,SOAB,SOSC,XNO,COCOB                                      GREAD129
      PRINT 119,SOAB,SOSC,XNO,COCOB                                     GREAD130
      IY = IP1                                                          GREAD131
      NP2=NX+2                                                          GREAD132
      NM1=NX-1                                                          GREAD133
      NM2=NX-2                                                          GREAD134
      IP2=IX+2                                                          GREAD135
      IP3=IX+3                                                          GREAD136
      IM1=IX-1                                                          GREAD137
      IM2=IX-2                                                          GREAD138
      IM3 = IX-3                                                        GREAD139
      I4=1                                                              GREAD140
      IA=NM1-IP1                                                        GREAD141
      EX2=-1./2.                                                        GREAD142
      EX3 = 1./3.                                                       GREAD143
      EX6 = -1./6.                                                      GREAD144
      XNV = .5                                                          GREAD145
      XNT = 1.5                                                         GREAD146
      BETV = 10.                                                        GREAD147
      BETT = 10./3.                                                     GREAD148
      DT2 = 2.*DT                                                       GREAD149
      G = 980.                                                          GREAD150
      CP = .239                                                         GREAD151
      PI = 3.1415927                                                    GREAD152
      GAM = .98E-4                                                      GREAD153
      GAM2 = 2.*GAM                                                     GREAD154
      ALF = -3.                                                         GREAD155
      XK1 = .4                                                          GREAD156
      XK2=.14                                                           GREAD157
      RALF = -1./ALF                                                    GREAD158
      RC = RALF/7.                                                      GREAD159
      T2 = (1. + ALF*RC)**2                                             GREAD160
      T3 = RC**EX3                                                      GREAD161
      CC = 3.*T3*T2                                                     GREAD162
      T4 = 3./CC                                                        GREAD163
      C32 = T4**(-.5)                                                   GREAD164
      T4 = T4**1.5                                                      GREAD165
      XK12 = XK1**2                                                     GREAD166
      SH = XK12*T4                                                      GREAD167
      HKK = SH*XK2**2/XK12                                              GREAD168
      HK2 = SH/XK12                                                     GREAD169
      HKK=HKK*10.                                                       GREAD170
      CPP=-CP*1.0E06                                                    GREAD171
      SIG=1.354E-12                                                     GREAD172
      AW=1000.*G                                                        GREAD173
      AR=2.87E+06                                                       GREAD174
      NTOP=NLAP+NP1                                                     GREAD175
      ATC = .001                                                        GREAD176
      SK = 0.86933E-06                                                  GREAD177
      PI2 = PI * 2.                                                     GREAD178
      DELH = (DT/86400.) * PI2                                          GREAD179
    1 PDECL  = DECL / .017453293                                        GREAD180
      PDCHG = DCHG  / .017453293                                        GREAD181
      PRINH = H     / .017453293                                        GREAD182
      PRINT 126,PDECL,PDCHG,EM,PRINH                                    GREAD183
      DO 117 I=1,NX                                                     GREAD184
      T1 = (Z(I) + Z(I+1))/2.                                           GREAD185
      ZA(I) = ABS(T1)                                                   GREAD186
      DZ(I) = Z(I+1) - Z(I)                                             GREAD187
  117 CONTINUE                                                          GREAD188
      DO 23K=1,IM1                                                      GREAD189
      I=IM1-K+1                                                         GREAD190
   23 DS(K)    = ZA(I)-ZA(I+1)                                          GREAD191
      DS(IX)   = ABS(Z(1)) - ZA(1)                                      GREAD192
      DO 715 I=IP1,NP1                                                  GREAD193
      TE=Z(I)-ZW                                                        GREAD194
      IF (TE)715,10,715                                                 GREAD195
   10 IZW=I                                                             GREAD196
      GO TO 132                                                         GREAD197
  715 CONTINUE                                                          GREAD198
      PRINT 1000,  (Z(I),I=1,NP1),ZW                                    GREAD199
      CALL EXIT                                                         GREAD200
  132 IZW1=IZW-1                                                        GREAD201
      T20=ALOG(Z(IZW)/Z(IZW1))                                          GREAD202
      A1 = ALOG(1950.  /Z(IZW1))/T20                                    GREAD203
      A2 = ALOG(Z(IZW)/1950.  )/T20                                     GREAD204
   99 RETURN                                                            GREAD205
  100 FORMAT(18A4)                                                      GREAD206
  101 FORMAT(1X18A4///)                                                 GREAD207
  110 FORMAT(14I5)                                                      GREAD208
  111 FORMAT (4H NX=,I3/4H IX=,I3/4H NT=,I3/7H GRID =,I3)               GREAD209
  112 FORMAT (11H  XIIN    = F10.4/11H   XJIN   = F10.4/11H PHI      = F8.2GREAD210
     1/11H DELTA T = F6.1/10H DISTANCE=,F7.2)                           GREAD211
  119 FORMAT(6F12.4)                                                    GREAD212
  120 FORMAT (6E12.5)                                                   GREAD213
  121 FORMAT ('0X-GRAD    ',6E12.5)                                     GREAD214
  122 FORMAT ('0Y-GRAD    ',6E12.5)                                     GREAD215
  123 FORMAT ('0',3A4,' GRADIENTS--INPUT VALUES'/' HEIGHTS(M)',11F10.2) GREAD216
  126 FORMAT(13H DECLINATION ,E12.4/8H CHANGE ,E12.4/ 36H INFRARED EMISSGREAD217
     1IVITY OF THE SURFACE ,E12.4/12H HOUR ANGLE ,E12.4)                GREAD218
 1000 FORMAT(1H1,'   ZW VALUE IS INCORRECT--- HEIGHT ARRAY FOLLOWS'//   GREAD219
     1  (6F12.4))                                                       GREAD220
 1212 FORMAT ('0TIME STEP FOR RADIATION IS',F10.2,' MINUTES')           GREAD221
      END                                                               GREAD222
      SUBROUTINE RAD
C     SUBROUTINE TO COMPUTE TEMPERATURE CHANGES DUE TO RADIATION
      INTEGER RDRUM,SDRUM,TDRUM
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
     1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
     2    ,WO,WSC,XKT,XYY,YY,GTO
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
     1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
     2    ,TT3(30),W3(30),SST
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1    ,XLAM,RSUM(15),B1,B2
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
     1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
     2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
     3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
     4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
     5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
     6    ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
     1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
     2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
     1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
     2    ,  T13,T14,T15,T16,XD1,YD1
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
     1 , I1IHT,I2IHT,I3IHT,I4IHT
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
      DIMENSION DTR(50)
      EQUIVALENCE (DTR(1),C(1))
  213 FORMAT ('0INITIAL PRES AND QS'/(1X2F15.5))
  106 NCL = NCLI
      IF(ITM.LT.ISTEP(1)) NCL=0
      CX = 1.
      RAINX = 0.
      IF(NCL)1108,1108,116
  116 CALL LINEAR (ITM,ISTEP,1,NTFOR, L,RAINI,RAINX,T4,T4,T4,T4,T4,T4)
      NCL = NXN(L)
      DO 934 I=1,NCL
      CALL LINEAR(ITM,ISTEP,1,NTFOR,L,ECLI(1,I),EC(I),T4,T4,T4,T4,T4,T4)
      TCL(I) = TCLI(L,I)
  934 LLC(I) = LLCI(L,I)
      CX = 1. -EC(NCL)
 1108 LLC(NCL+1) = 61
      DO 107I=IM1,NP1
      TA(I)=TT2(I)
      QA(I)=W2(I)
      COB(I) = PP12(I)*COCOB
  107 CONTINUE
C  FOLLOWING RECOMUTES EMISSIUIY H20,CO2 ATEACH STATION WHEN XD.GT.50KM
 1407 ICOM = -1
      IF (XD.GT. 50.E5) GO TO 112
      IF(IS.NE.1) GO TO 1507
  112 INEWC = INEWC+1
      IF (INEWC-INEW) 1507,1505,1505
 1505 INEWC = 0
      ICOM = 1
 1507 CONTINUE
 1408 C1 = 3.7943/PA(IP1)
C  COMPUTE PATH LENGTHS,ST4,QS
      TTW = TW
      DO 104 L=IP1,NP1
      K=L-IX
      IF (ICOM) 501,501,702
  702 DUW(K)=(PA(L)-PA(L+1))*(QA(L)+QA(L+1))/G/2.
      TTW = TTW+DUW(K)
C   CARBON DIOXIDE ASSUMED AT 320 PPM
      COA(K) = .4148239*(PA(L)-PA(L+1))
  501 IF (IPOL) 499,499,709
  499 CGA(K) = 0.
      PAAB(K) = 0.
      PASA(K) = 0.
      GO TO 502
  709 T8  = (COB(L)+COB(L+1))/2.*DZ(L)*1.E-5
      CGA(K) = T8*1.66*XNO
      PAAB(K) = T8*SOAB
      PASA(K) = T8*SOSC
  502 ST4(L) = SIG*TA(L)**4
      DST4(L) = SIG*((TA(L)+TA(L+1))/2.)**4
      CXPA = 3.7943/PA(L)
      TEX = 3.0 + 7.5 *(TA(L)-273.16)/(TA(L)-35.66)
      QS(L) = CXPA * 10.0**TEX
  104 CONTINUE
      KA = NP1-IX   +1
      IF (ICOM.EQ.1) CALL INFRAI(DUW,COA,KA,NATAL)
      IF (ITM-1) 212,212,297
  212 PRINT 213, (PA(I),QS(I),        I=IY,NP1)
C  *** SOLAR RADIATION COMPUTATIONS
  297 T3 = COS(H)
      T4 = COS(DECL)
      T6 = SIN(DECL)
      T5 = SPH*T6+CPH*T3*T4
      COSZ = T5
      H = H + DELH
      IF(H.LE.PI) GO TO 2
      H = H-PI2                                                         RAD110
      DECL= DECL+ DCHG                                                  RAD111
      PDECL = DECL/.017453293                                           RAD112
      PRINT 299,ITM,PDECL                                               RAD113
  299 FORMAT(//' MIDNIGHT OCCURS AT TIME STEP',I5,' NEW DECLINATION IS' RAD114
     1,E12.4)                                                           RAD115
    2 IF(T5)5,5,19                                                      RAD116
    5 CRS = 0.                                                          RAD117
      TE = 0.                                                           RAD118
      RH = 0.                                                           RAD119
      TOUPRA = 0.                                                       RAD120
      DO 6I=1,NP1                                                       RAD121
    6 DTDT(I) = 0.                                                      RAD122
      GO TO 99                                                          RAD123
   19 N1 = NP1 - IX                                                     RAD124
      CALL SOLAR2 (N1 ,PA(IY),DUW,PASA,PAAB,EC,TCL,LLC,COSZ,DTDT(IY),   RAD125
     1 CRS,TE,TOUPRA,NATAL)                                             RAD126
      GO TO (86,86,86,1414), IGOGO                                      RAD127
   86 SINZ = SQRT(1.-COSZ*COSZ)                                         RAD128
      SRS = -.0139 + .0467 * (SINZ/COSZ)                                RAD129
      SRS = AMIN1(1.,SRS)                                               RAD130
      SRS = AMAX1(.03,SRS)                                              RAD131
 1414 CONTINUE                                                          RAD132
      RAI(IX) = CRS * (1.-SRS)                                          RAD133
      TOUPRA = TOUPRA + CRS*SRS                                         RAD134
      RH = RAI(IX)                                                      RAD135
      IF(IGONY.GT.0) GO TO 99                                           RAD136
 6843 SECZ = 1./COSZ                                                    RAD137
      IF(SECZ.GT.10.) SECZ = 10.                                        RAD138
      IF(RAI(IX).LE.1.0E-30) RAI(IX) = 0.0                              RAD139
      DO 25 M=2,IX                                                      RAD140
      I = IX-M+2                                                        RAD141
      T2 = ZA(I-1)/100.                                                 RAD142
      CALL KAPPA(T2,AK)                                                 RAD143
      IF(RAI(I).LT.1.0E-20) RAI(I)=0.0                                  RAD144
      T100 = -AK*ZA(I-1)*SECZ/100.                                      RAD145
      IF(T100.LE.-40.0) T100 = -40.0                                    RAD146
      RAI(I-1) = RAI(IX)*EXP(T100)                                      RAD147
   25 DTR(I) = RAI(I) - RAI(I-1)                                        RAD148
      DTR(1) = RAI(1)                                                   RAD149
      DO 27I=1,IM1                                                      RAD150
      M=IX-I+1                                                          RAD151
   27 DTDT(I) = DTR(I) / DS(M)                                          RAD152
      RH = RAI(IX) - RAI(IM1)                                           RAD153
C  INFRARED SURFACE FLUX                                                RAD154
   99 CALL INFRA (1,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)    RAD155
      RAA = RA(1) + RADMX                                               RAD156
      RSUM(6) = DT*RA(1) + RSUM(6)                                      RAD157
C   *** HEAT BALANCE                                                    RAD158
      LOOP = 0                                                          RAD159
      TG1= TA(IP1)                                                      RAD160
      IF(TG1- 273.16)855,855,860                                        RAD161
  855 XLT = 677.                                                        RAD162
      GO TO 861                                                         RAD163
  860 XLT = 597.3 - 0.57*(TG1-273.16)                                   RAD164
  861 T5 = 1. / (EM * SIG)                                              RAD165
      IF(RAINX.GT.0) GO TO 862                                          RAD166
      TRW = TA(IP1)                                                     RAD167
      GO TO 865                                                         RAD168
  862 TWBAR = 0.                                                        RAD169
      NC = 0                                                            RAD170
C     RAINFALL THROUGH LAYER COMPUTATION                                RAD171
      DO 864I=IP2,NP1                                                   RAD172
      ZWS = Z(I)                                                        RAD173
      IF(ZW.GT.ZWS.AND.ZWS.GT.0.) GO TO 863                             RAD174
      SN = NC                                                           RAD175
      TRW = TWBAR/SN                                                    RAD176
      GO TO 865                                                         RAD177
  863 NC = NC+1                                                         RAD178
      TWBAR = TWBAR + (TA(I)-XLT*1.E-03/CP * (QS(I)-QA(I)))             RAD179
  864 CONTINUE                                                          RAD180
  865 ET1 = -.001 * ROA * XKT(IP1)                                      RAD181
      N = 1                                                             RAD182
      AT1 = -ROA * CP * XKT(IP1)                                        RAD183
      ST1 = ROW * CW * XKT(IM1)                                         RAD184
  532 CONTINUE                                                          RAD185
      ET = ET1 * ((W2(IP2) - W2(IP1)) / Z(IP2))                         RAD186
      AT = AT1 * ((TA(IP2) - TA(IP1)) / DZ(IP1)   + GAM )               RAD187
      ST = ST1 * ((TA(IP1) - TA(IM1)) / DZ(IM1))                        RAD188
C     RAIN EFFECT TERM  -PT-                                            RAD189
      PT = .935*RAINX*(TRW-TA(IP1))                                     RAD190
      T4 = T5 *(RH + RAA - AT - ST -XLT*ET + PT)                        RAD191
      IF(T4)74,74,870                                                   RAD192
   74 IF(LOOP)75,75,203                                                 RAD193
   75 PRINT 150,ITM,ET,AT,ST,XLT, RAA ,RH,SRS                           RAD194
      TG3 = TG1/2.                                                      RAD195
      GO TO 871                                                         RAD196
  870 TG3 = T4**.25                                                     RAD197
  871 GO TO (199,200,200),N                                             RAD198
  199 N = 2                                                             RAD199
      DET1 = TG3-TG1                                                    RAD200
      TG = TG3                                                          RAD201
      IF(ABS(DET1)-ATC)882,882,181                                      RAD202
  200 DET2 = TG3-TG2                                                    RAD203
      IF(ABS(DET2)-ATC)105,105,186                                      RAD204
  105 TG = (TG2+TG3)/2.                                                 RAD205
      GO TO 882                                                         RAD206
  186 IF(ABS(DET1)-ATC)882,882,1106                                     RAD207
 1106 IF(DET1)191,882,192                                               RAD208
  191 IF(DET2)193,193,184                                               RAD209
  192 IF(DET2)184,193,193                                               RAD210
  184 N=3                                                               RAD211
      GO TO 203                                                         RAD212
  193 TG1 = TG2                                                         RAD213
      GO TO (199,202,203),N                                             RAD214
  202 TG = TG3                                                          RAD215
      DET1 = DET2                                                       RAD216
      GO TO 181                                                         RAD217
  203 DET1 = DET1/2.                                                    RAD218
      TG = TG1 + DET1                                                   RAD219
  181 LOOP = LOOP + 1
      TG2 = TG
      IF(LOOP-25)884,884,97
  884 TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)
      QSG = C1*10.0**TEX
      W2(IP1) = QSG*XMQ+(1.-XMQ)*W2(IP2)
      TA(IP1) = TG
      GO TO 532
  882 CONTINUE
      IF (W2(IP1).GT.QSG) W2(IP1) = QSG
      GO TO 404
   97 PRINT 151,ITM,ET,AT,ST,XLT, RAA ,RH,SRS ,TG
  150 FORMAT(15H  IN TIME STEP ,I3,' T**4 INITIALLY COMPUTED LESS THAN Z
     XERO'//'VALUES OF ET,AT,ST,XLT, RAA ,RH AND SRS FOLLOW'/7E12.4)
  151 FORMAT(15H  IN TIME STEP ,I3,' AFTER 25 ITERATIONS T(Z=0) DID NOT
     XCONVERGE TO WITHIN THE SPECIFIED TOLERANCE'//'VALUES OF ET,AT,ST,X
     XLT, RAA ,RH, SRS,TG FOLLOW',/8E12.4)
  404 IX1 = IX+2
  405 II = NP1-IX
C  *** INFRARED ATMOSPHERIC COOLING
      CALL INFRA(NX,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)
 1607 DO 1621 I=IX1,NP1
      L = I-IX
 1621 DT1(I) = DTDT(I)+DTT(L)
      DO 4999K=1,IM1
 4999 DT1(K) = DTDT(K)
      TSC(IX) =    TG    - TTO(IP1)
      TSC(IP1) = TSC(IX)
      TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)
      QSG = C1*10.0**TEX
      W2(IP1) = QSG
      W2(IP1)=W2(IP1)*XMQ+(1.-XMQ)*W2(IP2)
      WSC(IP1) = W2(IP1)-WO(IP1)
C  RADIATION AND HEAT BALANCE SUMS
      RSUM(1) = RSUM(1) + DT * ET * XLT
      RSUM(2) = RSUM(2) + DT * AT
      RSUM(3) = RSUM(3) + DT * ST
      RSUM(4) = RSUM(4) + DT * PT
      RSUM(5) = RSUM(5) + DT * RH
      RSUM(7) = RSUM(7) + DT * RADMX
      RSUM(8) = RSUM(8) + DT * TG**4 * SIG * EM
      RSUM(9) = RSUM(9)+DT*(TE-TOUPRA)
      K = NP1-IX+1
      RSUM(10)= RSUM(10)+DT*(RA(K)-RB(K))
      XT2 = TSC(IX)
      RANS = RA(K) * 1.E3
      RABNS= RB(K) * 1.E3
      RABS = RB(1) * 1.E3
      CRNS = TE * 1.E3
      TRAUS= (RB(K)-RA(K) + CRS*SRS) * 1.E3
      DO 5000  I=1,NP1
      TT2(I)=TSC(I)
 5000 W2(I)=WSC(I)
      HAI = AT
      HSI= ST
      CE = ET - RAINX
      RETURN
      END
      SUBROUTINE EXCK
      INTEGER RDRUM,SDRUM,TDRUM
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
     2   ,WO,WSC,XKT,XYY,YY,GTO
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
     2   ,TT3(30),W3(30),SST
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
     2   ,  T13,T14,T15,T16,XD1,YD1
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
     1 , I1IHT,I2IHT,I3IHT,I4IHT
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
      DOUBLE PRECISION AA(9)
C     PST  AND  PSS  TABLES FOR TALOP  REPLACED BY -AA-
      DATA AA/0.79701864,0.131710842E-03,-0.611831499E-07,.588194023E-01
     X,-0.25310441E-02,0.287971530E-05,-0.811465413E-02,0.389187483E-04,
     X.47660041E-04/
 3000 DO 1  I=1,NP1
      IF (DABS(U2(I)).LT.( 1.E-35))  U2(I)=0.
      IF (DABS(V2(I)).LT.( 1.E-35))  V2(I)=0.
   86 T1=U2(I)**2 + V2(I)**2
      WS(I) = SQRT(T1)
    1 CONTINUE
      IF(XLAM)106,105,106
  105 W9=WS(IZW)*A1+WS(IZW1)*A2
  401 HBAR=1.54165E-04*(W9**2)                                          EXCK055
      H3=1.39536*HBAR                                                   EXCK056
  405 T23 = SQRT(G)                                                     EXCK057
  403 DO 100  I=1,NP1                                                   EXCK058
      T21=HBAR/(DEL*2.*PI)                                              EXCK059
      IF(T21)1001,1001,1002                                             EXCK060
 1001 CSW(I)=0.                                                         EXCK061
      GO TO 100                                                         EXCK062
 1002  T22=1./SQRT(T21)                                                 EXCK063
      T24=-ZA(I)*2.*PI*DEL/HBAR                                         EXCK064
      IF (T24+75.) 300,301,301                                          EXCK065
  300 CSW(I)=0.                                                         EXCK066
      GO TO 100                                                         EXCK067
  301 CSW(I)=T23*T22*EXP(T24)*DEL                                       EXCK068
  100 CONTINUE                                                          EXCK069
      TK=XK2**2                                                         EXCK070
  407 DO 101  I=1,IM1                                                   EXCK071
      T25=ZA(I)+HBAR/2.                                                 EXCK072
      CK0(I)=TK*(T25**2)                                                EXCK073
  101 CONTINUE                                                          EXCK074
  409 DO 102  I=IP1,NX                                                  EXCK075
      T26 = ZA(I)+HBAR/2.                                               EXCK076
      CK0(I)=XK12*(T26**2)                                              EXCK077
  102 CONTINUE                                                          EXCK078
  411 XKU(IP1)=CK0(IP1)*CSW(IP1)                                        EXCK079
      XKT(IP1)=XKU(IP1)                                                 EXCK080
      XKU(IM1)=CK0(IM1)*CSW(IM1)                                        EXCK081
      XKT(IM1)=XKU(IM1)                                                 EXCK082
  106 J2=IM2                                                            EXCK083
      IMA =    IHT - 1                                                  EXCK084
      IF(IMA.EQ.0) IMA=1                                                EXCK085
      IIPP1 = IP1-IMA  + 1                                              EXCK086
      GO TO(412,413,413,412),IGOGO                                      EXCK087
  412 IMA = IP1                                                         EXCK088
      IIPP1 = IP1                                                       EXCK089
      J2 = NX                                                           EXCK090
  413 DO 41 J=IMA,IP2,IIPP1                                             EXCK091
      DO 40 I=J,J2                                                      EXCK092
      T1 = (U2(I+1) - U2(I))/DZ(I)                                      EXCK093
      IF (ABS(T1) .LT.(1.E-35))  T1 = 0.                                EXCK094
  131 T1 = T1**2                                                        EXCK095
  132 T2 = (V2(I+1) - V2(I))/DZ(I)                                      EXCK096
      IF (ABS(T2) .LT.(1.E-35))  T2 = 0.                                EXCK097
  141 T2 = T2**2                                                        EXCK098
  142 T3 = T1 + T2                                                      EXCK099
      XCS =  SQRT(T3)                                                   EXCK100
      IF (I.EQ.1) CSOUT(1) = XCS                                        EXCK101
      IF (I.EQ.NX)CSOUT(2) = XCS                                        EXCK102
      TB =  (TT2(I+1)+TT2(I))/2.+TB0(I)                                 EXCK103
      T6 = XCS   + CSW(I)                                               EXCK104
      T7 = T6**2                                                        EXCK105
      T6 = CK0(I)*T6                                                    EXCK106
      CL =  (TT2(I+1)-TT2(I))/DZ(I)                                     EXCK107
    3 IF(I-IX)6,40,4                                                    EXCK108
C   ATMOSPHERIC                                                         EXCK109
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    4 CL = CL+GAM+GTO(I)+.00061*TB*((W2(I+1)-W2(I))/DZ(I)+GWO(I))
      T7 = TB*T7
      T11= G*CL/TB
      T12 = HK2*CKO(I)
      TEST = RALF
      GO TO 8
C  OCEANIC
    6 SB = (W2(I+1)+W2(I))/2.+WBO(I)
      TTB= TB-273.16
      PST(I) = AA(4)+2.*AA(7)*TTB+AA(5)*SB   +3.*AA(9)*TTB**2 +
     X 2.*AA(8)*SB   *TTB + AA(6)*SB   **2
      PSS(I) = AA(1)+AA(5)*TTB+2.*AA(2)*SB   +AA(8)*TTB**2+2.*AA(6)*
     X SB   *TTB + 3.*AA(3)*SB   **2
      IF (SB.LE.0)  PSS(I)=0.
      T4 = PST(I)*CL+PST(I)*GTO(I)
      T5 = PSS(I)*(W2(I+1) - W2(I))/DZ(I)+PSS(I)*GWO(I)
      CL = -.001*(T4+T5)
      T11 = G*CL
      TEST = 1.E16
      T12 = HK2 * ZDL2(I)
    8 IF(T7)1003,1003,1004
 1003 IF (CL) 35,19,10
 1004 IF (CL) 1030,19,1031
   19 RI(I) = 0.
      GO TO 15
C     CHECK MAGNITUDE OF CL(I)/T7 TO RESTRICT OVERFLOW EXCEPTION
 1030 CLL1 = ABS(CL)
      CLL=ALOG10(CLL1)
      GO TO 1032
 1031 CLL  = ALOG10(CL)
 1032 T7L=ALOG10(T7)
      CHECK1 = CLL-T7L
      IF(CHECK1-13.)1024,10,10
 1024 RI(I)= G*CL/T7
      IF(RI(I)-TEST)15,15,10
   10 RI(I) = TEST
   15 IF(RI(I))25,20,20
C  RI G.T. ZERO
   20 IF(I-IX)21,21,22
C  OCEANIC
   21 EV = BETV
      ET = BETT
      XV = -XNV
      XT = -XNT
      GO TO 23
C  ATMOSPHERIC
   22 EV = ALF
      ET = ALF
      XV = 2.
      XT = 2.
   23 T8 = (1. + EV*RI(I))**XV
      T9 = (1. + ET*RI(I))**XT
      XKU(I) = T6*T8
      XKT(I) = T6*T9
      GO TO 40
   25 IF(RI(I) + RC)35,35,30
C   RI G.T. -RC, AND L.T. ZERO
   30 T10 = 1. - ALF*RI(I)
      XKU(I) = T6/T10**2
      XKT(I) = XKU(I)/T10
      GO TO 40
C   RI L.E. -RC
   35 T11 = ABS(T11)
      XKT(I) = T12*SQRT(T11)
      IF(T7)1006,1006,1007
 1006 XKU(I)=0.
      GO TO 40
 1007 T13 = ABS(RI(I))
      T13 = T13**EX6
      XKU(I) = XKT(I)*C32*T13
   40 CONTINUE
      J2=NX
   41 CONTINUE
C   SET LIMITS ON ATMOSPHIC   K
      T13 = 1.E7
      TEST = XLAM**2
      IF(IGONY.LT.1) TEST = H3**2
  415 DO 60 I=IP1,NX
      IF (ZA(I).GE.(1.E4)) TEST=1.E4
      IF (XKU(I).LT.TEST)  XKU(I) = TEST
      IF (XKT(I).LT.TEST)  XKT(I) = TEST
      IF (XKT(I).GT.T13)   XKT(I) = T13
      IF (XKU(I).GT.T13)   XKU(I) = T13
   60 CONTINUE
C     SET LIMITS ON OCEANIC K
 1009 DO 1013  I=1,IM1
      IF(XKT(I)-.0014)1011,1011,1017
 1017 IF(XKU(I)-.014) 1012,1012,1013
 1011 XKT(I)=.0014
 1012 XKU(I)=.0140
 1013 CONTINUE
   99 RETURN
      END
      SUBROUTINE BIV
      INTEGER RDRUM,SDRUM,TDRUM
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
     2   ,WO,WSC,XKT,XYY,YY,GTO
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
     2   ,TT3(30),W3(30),SST
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNC,CPH,SPH,PHI,H,IGONY,NTCUV
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
     2   ,  T13,T14,T15,T16,XD1,YD1
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
     1 , I1IHT,I2IHT,I3IHT,I4IHT
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
C *******                    ***** BIV    ******                *******
      T41 = TT2(IP1) - 273.16 + TTO(IP1)
      T21 = TT2(IP1) -  35.66 + TTO(IP1)
      T31 = 3.0   + 7.5  *T41/T21
      QSG = C1*10.**T31
C     COMPUTE  W  SCALE FACTORS AT INTERFACE IN INITIAL TIME STEP
      IF (ITM-1) 1,2,2
    1 IF (IGONY) 111,111,112
  111 WO(IP1) = QSG
  112 W2(IP1) =0.0
      DWO(IP1)=WO(IP2)-WO(IP1)
      GWO(IP1)=DWO(IP1)/Z(IP2)
      GO TO 11
    2 W2(IP1)=OSG*XMQ+(1.-XMQ)*(W2(IP2)+WO(IP2))-WO(IP1)                BIV055
   11 IF(DEL)20,40,20                                                     BIV056
C     SEC.  3.3.1                                                         BIV057
   20 T1 = ROA*XKU(IP1) / DZ(IP1)                                         BIV058
      T2 = ROW*XKU(IM1) / DZ(IM1)                                         BIV059
      T3 = T1*U2(IP2) + T2*U2(IM1)                                        BIV060
      T4 = T1*V2(IP2) + T2*V2(IM1)                                        BIV061
      T5 = T1 + T2                                                        BIV062
      U2(IX) = T3/T5                                                      BIV063
      V2(IX) = T4/T5                                                      BIV064
      GO TO (60,61,64,60),IGOGO                                           BIV065
   61 IF(IANV.EQ.1) GO TO 62                                              BIV066
      U2(IX)= 0.0                                                         BIV067
      U2(IP1) = U2(IX)                                                    BIV068
      V2(IP1) = V2(IX)                                                    BIV069
      GO TO 70                                                            BIV070
   62 V2(IX) = 0.0                                                        BIV071
      V2(IP1) = V2(IX)                                                    BIV072
      U2(IP1) = U2(IX)                                                    BIV073
      GO TO 70                                                            BIV074
   60 U2(IX) =0.0                                                         BIV075
      U2(IP1) = 0.0                                                       BIV076
      V2(IX) = 0.0                                                        BIV077
      V2(IP1) = 0.0                                                       BIV078
      GO TO 70                                                            BIV079
   64 U2(IP1) = U2(IX)                                                    BIV080
      V2(IP1) = V2(IX)                                                    BIV081
   70 T10 = U2(IX)**2 + V2(IX)**2                                         BIV082
      WS(IX) = SQRT(T10)                                                  BIV083
      WS(IP1) = WS(IX)                                                    BIV084
 1001 T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3                               BIV085
      IF(ITM.EQ.0) CE = 0.                                                BIV086
      CF=W2(IM1)*CE/T8+WO(IM1)*CE/T8                                      BIV087
      T9 = +CF/ROW/XKT(IM1)                                               BIV088
   30 W2(IX) = T9 * DZ(IM1) + W2(IM1) - DWO(IM1)                          BIV089
      IF(ITM-1)32,99,99                                                   BIV090
   32 WO(IX) = T9 * DZ(IM1) + WO(IM1)                                     BIV091
      W2(IX) = 0.0                                                        BIV092
      DWO(IM1) = WO(IX) - WO(IM1)                                         BIV093
      GWO(IM1) = DWO(IM1) /(-Z(IM1))                                      BIV094
   31 GO TO 99                                                            BIV095
C     SEC.  3.3.2                                                         BIV096
   40 CONTINUE                                                            BIV097
      T3 = B1 + SQRT(ROA/ROW) * B2                                        BIV098
      T4 = WS(IP2) - WS(IM1)                                              BIV099
      IF(XLAM) 41,41,42                                                   BIV100
   41 UST = WS(IP2)/ B1                                                   BIV101
      GO TO ( 141,141,141,142),IGOGO                                      BIV102
  142 WS(IX) = 0.                                                         BIV103
      GO TO 43                                                            BIV104
  141  WS(IX) = WS(IM1) + SQRT(ROA/ROW) * UST * B2                        BIV105
      GO TO 43                                                            BIV106
   42 UST = T4/T3                                                         BIV107
      WS(IX) = WS(IP2)-UST*B1                                             BIV108
   43 WS(IP1) = WS(IX)                                                    BIV109
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      T5 = WS(IP2) - WS(IX)
      T6 = T5/T4
      U2(IX) = U2(IP2) - (U2(IP2) - U2(IM1))*T6
      V2(IX) = V2(IP2) - (V2(IP2) - V2(IM1))*T6
      IF(IGONY.EQ.0) GO TO 44
      U2(IX) = 0.
      V2(IX) = 0.
   44 U2(IP1) = U2(IX)
      V2(IP1) = V2(IX)
      QST = (W2(IP2) - W2(IP1))/B1+DWO(IP1)/B1
      T7 = ABS(UST)
      IF(ITM.EQ.0) RAINX=0.
      CE =(-ROA*T7*QST/1000.)-RAINX
      T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3
      CF = W2(IM1)*CE/T8+WO(IM1)*CE/T8
      XKU(IP1) = UST**2 * DZ(IP1) / WS(IP2)
      XKT(IP1) = XKU(IP1)
      IF(IGONY.GT.0) GO TO 99
   49 XKU(IM1) = UST**2 * DZ(IM1) / ABS(WS(IX)-WS(IM1)) * (ROA/ROW)
      XKT(IM1) = XKU(IM1)
      SST = CF/SQRT(ROW*ROA)/T7
   50 W2(IX) = W2(IM1) + SST*B2 - DWO(IM1)
   51 IF(ITM-1)52,99,99
   52 WO(IX) = CF/ROW/XKT(IM1)*DZ(IM1)+WO(IM1)
      W2(IX) = 0.0
      DWO(IM1) = WO(IX) - WO(IM1)
      GWO(IM1) = DWO(IM1) /(-Z(IM1))
   99 IF (IPOL-1) 999,992,990
  990 CALL LINEAR (ITM,ITS2,1,ISSI2,L,SOU2,T2,T4,T4,T4,T4,T4,T4)
      SH2(20) = T2
      T2 = SH2(1) * T2
      PP22(IP1) = T2*DZ(IP1)/XKT(IP1)/ROA+PP22(IP2)
  992 CALL LINEAR (ITM,ITS1,1,ISSI1,L,SOU1,T1,T4,T4,T4,T4,T4,T4)
      SH1(20) = T1
      T1 = SH1(1) * T1
      PP12(IP1) = T1*DZ(IP1)/XKT(IP1)/ROA+PP12(IP2)
  999 RETURN
C *******                 ***** CTW    ******             *******
      ENTRY CTW(X1,X2,X3,XO)
C     COMPUTE COEFFICIENTS FOR T,W IN ATMOSPHERE OR OCEAN
      DOUBLE PRECISION Z1,Z2,Z3,AD,AAD,AAAD
      DOUBLE PRECISION X1,X2,X3,XO,CX
      DIMENSION X1(1),X2(1),X3(1),XO(1)
      A(I1)=0.
      Z1=DT2/(DZ(II)+DZ(I1))
      Z2=XKT(I1)/DZ(I1) + 0.5*VVEL(II)
      Z3=XKT(II)/DZ(II) - 0.5*VVEL(II)
      C(I1)=-Z1*Z3
      B(I1)=C5+Z1*(Z3+Z2)
      AD=C6*X2(II)+Z2*Z1*(X2(I1)+XO(I1))-GD2*(X1(II))
      AAD=DT*FA(II)
      AAAD=(B(I1)-C5)*XO(II)+C(I1)*XO(II+1)
      D(I1)=AD+AAD-AAAD
      DO210  J=II,IT
      Z1=DT2/(DZ(J+1)+DZ(J))
      Z2=XKT(J)/DZ(J)   + 0.5*VVEL(J+1)
      Z3=XKT(J+1)/DZ(J+1) - 0.5*VVEL(J+1)
      A(J)=-Z1*Z2
      C(J)=-Z1*Z3
      B(J)=C5+Z1*(Z3+Z2)
      D(J)=C6*X2(J+1)-GD2*X1(J+1)+DT*FA(J+1)
      D(J)=D(J)-(A(J)*XO(J)+(B(J)-C5)*XO(J+1)+C(J)*XO(J+2))
  210 CONTINUE
      D(IT)=D(IT)+Z1*Z3*(X2(IT+2)+XO(IT+2))+C(IT)*XO(IT+2)
      C(IT)=0.
      CST(I1)=-C(I1)/B(I1)
      DST(I1)=D(I1)/B(I1)
      DO211 J=I1,I2
      Z1=A(J)*CST(J-1)+B(J)
      CST(J)=-C(J)/Z1
      Z2=D(J)-A(J)*DST(J-1)
  211 DST(J) = Z2/Z1
      Z1=D(IT)-A(IT)*DST(I2)
      Z2=A(IT)*CST(I2)+B(IT)
      X3(I3)=Z1/Z2
      IF(IGONY.GT.0) GO TO 212
      IF (IHT.EQ.1) GO TO 212
      IIHT = IHT -1
      DO 256 I=1,IIHT
  256 X3(I) = 0.
  212 DO221 J=I4,I5
      NR=IT-J
      CX = CST(NR) * X3(NR+2)
  221 X3(NR+1) = CX + DST(NR)
      RETURN
      END
```

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 SUBROUTINE TEMPRT                                                 TMPRT000
 INTEGER RDRUM,SDRUM,TDRUM                                         TMPRT001
 DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     TMPRT002
1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    TMPRT003
2   ,WO,WSC,XKT,XYY,YY,GTO                                         TMPRT004
 COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        TMPRT005
1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      TMPRT006
2   ,TT3(30),W3(30),SST                                            TMPRT007
 COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,TMPRT008
1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CETMPRT009
2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             TMPRT010
 COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               TMPRT011
1   ,XLAM,RSUM(15),B1,B2                                           TMPRT012
 COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    TMPRT013
1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  TMPRT014
2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   TMPRT015
3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  TMPRT016
4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        TMPRT017
5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              TMPRT018
6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         TMPRT019
7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)TMPRT020
 COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      TMPRT021
1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    TMPRT022
2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) TMPRT023
 COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      TMPRT024
 COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   TMPRT025
1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     TMPRT026
2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  TMPRT027
3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    TMPRT028
4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           TMPRT029
5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                   TMPRT030
 COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     TMPRT031
1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     TMPRT032
 COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    TMPRT033
2    ,  T13,T14,T15,T16,XD1,YD1                                    TMPRT034
3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        TMPRT035
 COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II TMPRT036
 COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     TMPRT037
1 , I1IHT,I2IHT,I3IHT,I4IHT                                        TMPRT038
 DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          TMPRT039
 EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     TMPRT040
1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             TMPRT041
 COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      TMPRT042
 COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      TMPRT043
 COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)               TMPRT044
 DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     TMPRT045
1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               TMPRT046
2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               TMPRT047
3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              TMPRT048
4  ,CP2X(30),CP2Y(30)                                              TMPRT049
 EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))              TMPRT050
 EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               TMPRT051
 EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))               TMPRT052
 EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))               TMPRT053
 EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))              TMPRT054
 EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))             TMPRT055
 EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))             TMPRT056
 EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))             TMPRT057
 EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))             TMPRT058
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      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))
      IF(ITM.LE.1)ICTR = 0
      ICTR = ICTR + 1
      IF(ICTR.LT.1)GO TO 888
      ICTR = 0
      PRINT 1, ITM,NS,MS
    1 FORMAT ('1TIME STEP',I5,' FOR STATION',2I5)
      GO TO (550,551,552,553),IGOGO
  550 PRINT 554
      GO TO 501
  554 FORMAT(1H+,40X,'(COASTAL CORNER STATION)')
  551 PRINT 555
      GO TO 501
  555 FORMAT(1H+,40X,'(COASTAL STATION)')
  552 PRINT 556
      GO TO 501
  556 FORMAT(1H+,40X,'(WATER STATION)')
  553 PRINT 557
  557 FORMAT(1H+,40X,'(LAND STATION)')
  501 PRINT 4
      DO 10 IP=1,NP1
      PRINT 2, Z(IP),U2(IP),V2(IP),TT2(IP),W2(IP),XKT(IP),PP12(IP),
     1  VVEL(IP),DT1(IP)
   10 CONTINUE
      PRINT 13, RANS,RABNS,RABS,RAA,CRNS,CRS,TOUPRA
   13 FORMAT(/'        RANS                RABNS                 RABS
     1     RAA          CRNS                CRS                TOUPRA'/
     2  7E18.8)
      PRINT 14, SRS,CE,CF,HAI,HSI,H3,TRAUS
   14 FORMAT(/'        SRS                  CE                    CF
     1     HAI                HSI                H3                 TRAUS '/
     2  7E18.8)
      PRINT 15, (RSUM(I),I=1,8)
   15 FORMAT(/'        LE                A                S                P
     1           R(1-A)            RA              MAN              T2**4
     2 '/ 8E16.6)
    4 FORMAT(//' HEIGHT           U2              V2              TEMP
     1  W2          XKT             PP1             VVEL            DT1 '/)
    2 FORMAT(9E14.5)
  888 RETURN
      ENTRY TEMGRA
      PRINT 5
    5 FORMAT(' THE FOLLOWING ARE COMPUTED GRADIENTS FOR RESTART'/'         P
     1UX            PUY             PVX             PVY             PTX
     2  PTY           PWX             PWY             HEIGHT'/)
      DO 6I=1,NP1
      PRINT 7, PUX(I),PUY(I),PVX(I),PVY(I),PTX(I),PTY(I),PWX(I),PWY(I),
     1 Z(I)
    6 CONTINUE
      PRINT 778
      DO 777 I=1,NP1
      PRINT 7,CUX(I),CUY(I),CVX(I),CVY(I),CTX(I),CTY(I),CWX(I),CWY(I)
     1,Z(I)
  777 CONTINUE
  778 FORMAT ('OCENTERED GRADIENTS')
    7 FORMAT(8E14.5,F8.0)
      RETURN
      END
      SUBROUTINE TTSQ                                                    TTSQ000
C     COMPUTE FCN  A  AND SET INDICES                                    TTSQ001
      INTEGER RDRUM,SDRUM,TDRUM                                          TTSQ002
      DOUBLE PRECISION Z1,Z2                                             TTSQ003
      DOUBLE PRECISION AZER(36)                                          TTSQ004
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12      TTSQ005
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3     TTSQ006
     2   ,WO,WSC,XKT,XYY,YY,GTO                                          TTSQ007
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)         TTSQ008
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)       TTSQ009
     2   ,TT3(30),W3(30),SST                                             TTSQ010
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, TTSQ011
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE TTSQ012
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2              TTSQ013
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                TTSQ014
     1   ,XLAM,RSUM(15),B1,B2                                            TTSQ015
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)     TTSQ016
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)   TTSQ017
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2    TTSQ018
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)   TTSQ019
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)         TTSQ020
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF               TTSQ021
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV          TTSQ022
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18) TTSQ023
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)       TTSQ024
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)     TTSQ025
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)  TTSQ026
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                       TTSQ027
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6    TTSQ028
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3      TTSQ029
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME   TTSQ030
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2     TTSQ031
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2            TTSQ032
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                    TTSQ033
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL      TTSQ034
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                      TTSQ035
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20     TTSQ036
     2    ,  T13,T14,T15,T16,XD1,YD1                                     TTSQ037
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                         TTSQ038
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II  TTSQ039
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)      TTSQ040
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                         TTSQ041
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)           TTSQ042
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))      TTSQ043
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))              TTSQ044
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                       TTSQ045
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                       TTSQ046
      COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)                TTSQ047
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)      TTSQ048
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)                TTSQ049
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)                TTSQ050
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)               TTSQ051
     4  ,CP2X(30),CP2Y(30)                                               TTSQ052
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))               TTSQ053
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))                TTSQ054
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))                TTSQ055
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))                TTSQ056
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))               TTSQ057
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))              TTSQ058
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))              TTSQ059
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))              TTSQ060
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))              TTSQ061
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))              TTSQ062
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))              TTSQ063
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))              TTSQ064
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))              TTSQ065
C *******             ***** TTSQ   ******            *******              TTSQ066
      IF (ITM.GT.1)GO TO 18                                              TTSQ067
      DO117 I=1,36                                                       TTSQ068
  117 AZER(I) =0.                                                        TTSQ069
   18 IF(NVCHS(2).EQ.1)GO TO 41                                          TTSQ070
C     T--OCEAN                                                           TTSQ071
      DO110  J=2,IM1                                                     TTSQ072
      Z1=U2(J)*PTX(J)+V2(J)*PTY(J)                                       TTSQ073
      FA(J)=-Z1+DT1(J)                                                   TTSQ074
  110 CONTINUE                                                           TTSQ075
      I1=1                                                               TTSQ076
      II=2                                                               TTSQ077
      IT=IM2                                                             TTSQ078
      I2=IM3                                                             TTSQ079
      I3=IM1                                                             TTSQ080
      I4=1                                                               TTSQ081
      IF(IGONY.EQ.1) GO TO 146                                           TTSQ082
      I5 = IT-  IHT+1                                                    TTSQ083
      IF(IHT.GT.2) GO TO 131                                             TTSQ084
  146 I5 = IM3                                                           TTSQ085
      I1 = 1                                                             TTSQ086
      II = 2                                                             TTSQ087
  131 CALL CTW(TT1,TT2,TT3,TTO)                                          TTSQ088
      IF(IGONY.EQ.1) GO TO 145                                           TTSQ089
C     W=S  OCEAN                                                         TTSQ090
      DO130 J=2,IM1                                                      TTSQ091
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)                                       TTSQ092
      FA(J)=-Z1                                                          TTSQ093
  130 CONTINUE                                                           TTSQ094
      CALL CTW(W1,W2,W3,WO)                                              TTSQ095
C     W=Q  ATMOSPHERE                                                    TTSQ096
  145 DO140 J=IP2,NX                                                     TTSQ097
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)                                       TTSQ098
      FA(J)=-Z1                                                          TTSQ099
  140 CONTINUE                                                           TTSQ100
   41 I1 = IP1                                                           TTSQ101
      II=IP2                                                             TTSQ102
      IT=NM1                                                             TTSQ103
      I2=NM2                                                             TTSQ104
      I3=NX                                                              TTSQ105
      I5=IA                                                              TTSQ106
      IF(NVCHS(2).EQ.1)GO TO 22                                          TTSQ107
      CALL CTW(W1,W2,W3,WO)                                              TTSQ108
C     T--ATMOSPHERE                                                      TTSQ109
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      DO120 J=IP2,NX                                                    TTSQ110
      Z1=U2(J)*PTX(J)+V2(J)*PTY(J)                                      TTSQ111
      Z2=GAM2/(DZ(J)+DZ(J-1))*(XKT(J)-XKT(J-1))                         TTSQ112
      Z3=U2(J)*SLOPX+V2(J)*SLOPY                                        TTSQ113
      FA(J)=-Z1+Z2+DT1(J) - VVEL(J) * GAM-Z3*GAM                        TTSQ114
  120 CONTINUE                                                          TTSQ115
      CALL CTW(TT1,TT2,TT3,TTO)                                         TTSQ116
   22 IF(IPOL-1)169,164,161                                             TTSQ117
  161 DO162 J=IP2,NX                                                    TTSQ118
      Z1 = U2(J)*XP2(J)+V2(J)*PP2Y(J)                                   TTSQ119
      Z2 = 0.                                                           TTSQ120
      IF ((J-IX).GT.6) GO TO 162                                        TTSQ121
      Z2 = SH2(20)*SH2(J-IX) /(Z(J+1)-Z(J-1))*2./ROA                    TTSQ122
  162 FA(J) = -Z1+Z2                                                    TTSQ123
      CALL CTW (PP21,PP22,PP23,AZER)                                    TTSQ124
  164 DO165 J=IP2,NX                                                    TTSQ125
      Z1 = U2(J)*XP1(J)+V2(J)*PP1Y(J)                                   TTSQ126
      Z2 = 0.                                                           TTSQ127
      IF ((J-IX).GT.6) GO TO 165                                        TTSQ128
      Z2 = SH1(20)*SH1(J-IX) /(Z(J+1)-Z(J-1))*2./ROA                    TTSQ129
  165 FA(J) = -Z1+Z2                                                    TTSQ130
      CALL CTW (PP11,PP12,PP13,AZER)                                    TTSQ131
  169 CONTINUE                                                          TTSQ132
      RETURN                                                            TTSQ133
C *******              ***** GWC   ******            *******            TTSQ134
      ENTRY GWC                                                         TTSQ135
C     COMPUTE GEOSTROPHIC WINDS AND CURRENTS                            TTSQ136
      DIMENSION SX(30),SY(30)                                           TTSQ137
      EQUIVALENCE (A(1),SX(1)),(B(1),SY(1))                             TTSQ138
C     STORE SCALED T AND W TEMPORARILY                                  TTSQ139
  371 DO3100  I=1,NP1                                                   TTSQ140
      TSC(I)=TT2(I)                                                     TTSQ141
      WSC(I)=W2(I)                                                      TTSQ142
C     COMPUTE UNSCALED T AND W FOR GWC,RAD,STOR                         TTSQ143
      TT2(I)=TT2(I)+TTO(I)                                              TTSQ144
 3100 W2(I)=W2(I)+WO(I)                                                 TTSQ145
      DO 310I=IP3,NX                                                    TTSQ146
      T1 = DZ(I-1)/TT2(I)**2                                            TTSQ147
      T101 = (TT2(I+1)+TT2(I)) / 2.                                     TTSQ148
      T101 = T101 - (TT2(I)+TT2(I-1)) / 2.                              TTSQ149
      T101 = T101 / ((DZ(I)+DZ(I-1))/2.)                                TTSQ150
      SX(I) = (CTX(I) - T101 * SLOPX) * T1                              TTSQ151
      SY(I) = (CTY(I) - T101 * SLOPY) * T1                              TTSQ152
  310 CONTINUE                                                          TTSQ153
      T1 = DZ(NX)/TT2(NP1)**2                                           TTSQ154
      XCTX = CTX(NP1) - ((TT2(NP1) - TT2(NX))/DZ(NX))*SLOPX             TTSQ155
      YCTY = CTY(NP1) - ((TT2(NP1) - TT2(NX))/DZ(NX))*SLOPY             TTSQ156
      SX(NP1) = T1*XCTX                                                 TTSQ157
      SY(NP1) = T1*YCTY                                                 TTSQ158
      CALL LINEAR (ITM,ICUV,4,NTCUV,J,XOCU,CU(IX),XOCV,CV(IX),XACU,     TTSQ159
     1  CU(NP1),XACV,CV(NP1))                                           TTSQ160
      CUT = CU(NP1)/TTO(NP1)                                            TTSQ161
      CVT = CV(NP1)/TTO(NP1)                                            TTSQ162
      DO330 J=IP2,NX                                                    TTSQ163
      SUMX = 0.                                                         TTSQ164
      SUMY = 0.                                                         TTSQ165
  315 J1=J+1                                                            TTSQ166
      DO320 I=J1,NP1                                                    TTSQ167
      SUMX = SUMX + SX(I)                                               TTSQ168
      SUMY = SUMY + SY(I)                                               TTSQ169
  320 CONTINUE                                                          TTSQ170
      T1 = GSF*TT2(J)                                                   TTSQ171
      TX = T1*SUMX                                                      TTSQ172
      TY = T1*SUMY                                                      TTSQ173
      CU(J) = CUT*TT2(J) + TY                                           TTSQ174
      CV(J) = CVT*TT2(J) - TX                                           TTSQ175
  330 CONTINUE                                                          TTSQ176
      GO TO (399,  1,1,399), IGOGO                                      TTSQ177
    1 IF(IHT.GT.1) GO TO 850                                            TTSQ178
      XETA2 = CV(IX)/GSF                                                TTSQ179
      YETA2 =-CU(IX)/GSF                                                TTSQ180
      GO TO 851                                                         TTSQ181
  850 CV(IX) = GSF * XETA2                                              TTSQ182
      CU(IX) = -GSF * YETA2                                             TTSQ183
  851 DO340 I=2,IX                                                      TTSQ184
      T3 =(CTY(I) + CTY(I-1))/2.                                        TTSQ185
      T4 =(CWY(I) + CWY(I-1))/2.                                        TTSQ186
      T1 = PST(I-1)*T3 + PSS(I-1)*T4                                    TTSQ187
      T5 = (CTX(I) + CTX(I-1))/2.                                       TTSQ188
      T6 = (CWX(I) + CWX(I-1))/2.                                       TTSQ189
      T2 = PST(I-1)*T5 + PSS(I-1)*T6                                    TTSQ190
      SX(I) = .001*T2*DZ(I-1)                                           TTSQ191
      SY(I) = .001*T1*DZ(I-1)                                           TTSQ192
  340 CONTINUE                                                          TTSQ193
      DO350 K=2,IX                                                      TTSQ194
      I=IX-K+1                                                          TTSQ195
      SUMX = 0.                                                         TTSQ196
      SUMY = 0.                                                         TTSQ197
      DO345 J=I,IM1                                                     TTSQ198
      SUMX = SUMX + SX(J+1)                                             TTSQ199
      SUMY = SUMY + SY(J+1)                                             TTSQ200
  345 CONTINUE                                                          TTSQ201
      CU(I) = CU(IX) + GFR*SUMY                                         TTSQ202
      CV(I) = CV(IX) - GFR*SUMX                                         TTSQ203
  350 CONTINUE                                                          TTSQ204
  399 RETURN                                                            TTSQ205
C *******               ***** CUV    ******           *******           TTSQ206
      ENTRY CUV                                                         TTSQ207
C     COMPUTE U AND V COEFFICIENTS FOR GAUSSIAN ELIMINATION SCHEME      TTSQ208
      A(I1) = 0.                                                        TTSQ209
      Z1 = DT2/(DZ(I1) + DZ(II))                                        TTSQ210
      Z2 = XKU(I1)/DZ(I1)                                               TTSQ211
      Z3 = XKU(II)/DZ(II)                                               TTSQ212
      BR(I1) = C5 + Z1*(Z3 + Z2)                                        TTSQ213
      BG     = -DTSF                                                    TTSQ214
      C(I1) = -Z1*Z3                                                    TTSQ215
      IF(I1-1) 111,111,12                                               TTSQ216
  111 IF(IHT.EQ.1) GO TO 11                                             TTSQ217
   35 IIHT = IHT -1                                                     TTSQ218
      DO 36 I=1,IIHT                                                    TTSQ219
      U3(I) = 0.                                                         TTSQ220
   36 V3(I) = 0.                                                         TTSQ221
      GO TO 13                                                           TTSQ222
   11 U3(I1) = U2(I1) + DTSF * (V2(I1)-CV(I1))                           TTSQ223
      V3(I1) = V2(I1) + DTSF * (CU(I1)-U2(I1))                           TTSQ224
      GO TO 13                                                           TTSQ225
   12 U3(IT+2) = CU(IT+2)                                                TTSQ226
      V3(IT+2) = CV(IT+2)                                                TTSQ227
   13 Z4 = C6 * U2(II) - DTSF * CV(II) - GD2 * U1(II)                    TTSQ228
     1 - DT * (U2(II) * PUX(II) + V2(II) * PUY(II))                      TTSQ229
      Z5 = Z1*Z2*U2(I1)                                                  TTSQ230
      Z6 = C6*V2(II) + DTSF*CU(II) - GD2*V1(II)                          TTSQ231
     1 - DT * (U2(II) * PVX(II) + V2(II) * PVY(II))                      TTSQ232
      Z7 = Z1*Z2*V2(I1)                                                  TTSQ233
      F(I1,1) = Z4 + Z5                                                  TTSQ234
      F(I1,2) = Z6 + Z7                                                  TTSQ235
      DO 30 I=II,IT                                                      TTSQ236
      Z1 = DT2/(DZ(I) + DZ(I+1))                                         TTSQ237
      Z2 = XKU(I)/DZ(I) + 0.5*VVEL(I+1)                                  TTSQ238
      Z3 = XKU(I+1)/DZ(I+1) - 0.5*VVEL(I+1)                              TTSQ239
      A(I) = -Z1*Z2                                                      TTSQ240
      BR(I) = C5 + Z1*(Z3 + Z2)                                          TTSQ241
      C(I) = -Z1*Z3                                                      TTSQ242
      F(I,1) = C6*U2(I+1) - DTSF*CV(I+1) - GD2*U1(I+1)                   TTSQ243
     1 - DT * (U2(I+1)* PUX(I+1)+ V2(I+1)* PUY(I+1))                     TTSQ244
      F(I,2) = C6*V2(I+1) + DTSF*CU(I+1) - GD2*V1(I+1)                   TTSQ245
     1 - DT * (U2(I+1)* PVX(I+1)+ V2(I+1)* PVY(I+1))                     TTSQ246
   30 CONTINUE                                                           TTSQ247
      C(IT) = 0.                                                         TTSQ248
      F(IT,1) = F(IT,1) + Z1*Z3*U2(IT+2)                                 TTSQ249
      F(IT,2) = F(IT,2) + Z1*Z3*V2(IT+2)                                 TTSQ250
      Z1 = 1./(BR(I1)**2 + BG**2)                                        TTSQ251
      E(I1,1,1) = Z1*BR(I1)                                              TTSQ252
      E(I1,1,2) = -Z1*BG                                                 TTSQ253
      E(I1,2,1) = -E(I1,1,2)                                             TTSQ254
      E(I1,2,2) = E(I1,1,1)                                              TTSQ255
      FST(I1,1) = E(I1,1,1)*F(I1,1) + E(I1,1,2)*F(I1,2)                  TTSQ256
      FST(I1,2) = E(I1,2,1)*F(I1,1) + E(I1,2,2)*F(I1,2)                  TTSQ257
      E(I1,1,1) = -C(I1)*E(I1,1,1)                                       TTSQ258
      E(I1,1,2) = -C(I1)*E(I1,1,2)                                       TTSQ259
      E(I1,2,1) = -E(I1,1,2)                                             TTSQ260
      E(I1,2,2) = E(I1,1,1)                                              TTSQ261
      DO 5 I=II,I2                                                       TTSQ262
      Z1 = A(I)*E(I-1,1,1) + BR(I)                                       TTSQ263
      Z2 = A(I)*E(I-1,1,2) + BG                                          TTSQ264
      Z3 = Z1**2 + Z2**2                                                 TTSQ265
      R(I,1,1) = Z1/Z3                                                   TTSQ266
      R(I,1,2) = -Z2/Z3                                                  TTSQ267
      R(I,2,1) = -R(I,1,2)                                               TTSQ268
      R(I,2,2) = R(I,1,1)                                                TTSQ269
      E(I,1,1) = -R(I,1,1)*C(I)                                          TTSQ270
      E(I,1,2) = -R(I,1,2)*C(I)                                          TTSQ271
      E(I,2,1) = -E(I,1,2)                                               TTSQ272
      E(I,2,2) = E(I,1,1)                                                TTSQ273
    5 CONTINUE                                                           TTSQ274
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      Z1 = A(IT)*E(I2,1,1) + BR(IT)                                     TTSQ275
      Z2 = A(IT)*E(I2,1,2) + BG                                         TTSQ276
      Z3 = Z1**2 + Z2**2                                                TTSQ277
      R(IT,1,1) = Z1/Z3                                                 TTSQ278
      R(IT,1,2) = -Z2/Z3                                                TTSQ279
      R(IT,2,1) = -R(IT,1,2)                                            TTSQ280
      R(IT,2,2) = R(IT,1,1)                                             TTSQ281
      DO 10 I=II,IT                                                     TTSQ282
      F(I,1) = F(I,1) - A(I)*FST(I-1,1)                                 TTSQ283
      F(I,2) = F(I,2) - A(I)*FST(I-1,2)                                 TTSQ284
      FST(I,1) = R(I,1,1)*F(I,1) + R(I,1,2)*F(I,2)                      TTSQ285
      FST(I,2) = R(I,2,1)*F(I,1) + R(I,2,2)*F(I,2)                      TTSQ286
   10 CONTINUE                                                          TTSQ287
      U3(I3) = FST(IT,1)                                                TTSQ288
      V3(I3) = FST(IT,2)                                                TTSQ289
      DO 20 I=I4,I5                                                     TTSQ290
      NR=IT-I                                                           TTSQ291
      EU3 = E(NR,1,1) *U3(NR+2)                                         TTSQ292
       EV3 = E(NR,1,2) *V3(NR+2)                                        TTSQ293
      U3(NR+1)=EU3+EV3+FST(NR,1)                                        TTSQ294
      EU3 = E(NR,2,1) *U3(NR+2)                                         TTSQ295
      EV3 = E(NR,2,2) * V3(NR+2)                                        TTSQ296
      V3(NR+1)=EU3+EV3+FST(NR,2)                                        TTSQ297
   20 CONTINUE                                                          TTSQ298
   99 CONTINUE                                                          TTSQ299
      RETURN                                                            TTSQ300
      END                                                               TTSQ301
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 SUBROUTINE SDATA
 INTEGER RDRUM,SDRUM,TDRUM
 DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
2    ,WO,WSC,XKT,XYY,YY,GTO
 COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
2    ,TT3(30),W3(30),SST
 COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
 COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
1    ,XLAM,RSUM(15),B1,B2
 COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
6    ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
7   ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
 COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
 COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
 COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
1   ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
2   ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
3   ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
4   ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
5   ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
 COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
 COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
2     ,  T13,T14,T15,T16,XD1,YD1
3   ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
 COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
 COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
1 , I1IHT,I2IHT,I3IHT,I4IHT
 DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
 EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
1   ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
 COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99
 COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)
 COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)
 DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)
1   ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)
2   ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)
3   ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)
4   ,CP2X(30),CP2Y(30)
 EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))
 EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))
 EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))
 EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))
 EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))
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      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))
      DIMENSION YIN2(1),YIN3(1),YIN4(1),YIN5(1)
      EQUIVALENCE (XYY(1,1,2),YIN2(1)),(XYY(1,1,3),YIN3(1))
     1     ,(XYY(1,1,4),YIN4(1)),(XYY(1,1,5),YIN5(1))
      DIMENSION VAR3(50)
      DIMENSION ALL(12,5) ,IALL(12,5)
      EQUIVALENCE (VAR3(1),C(1)) ,(IALL(1,1),ALL(1,1))
      DOUBLE PRECISION XTIME,XT1
C  SUBROUTINE TO SET DATA AT EACH STATION INITIALLY AND AT EACH RESTART
      IF (ITM) 11,11,301
   11 IF (IS-1) 12,12,1313
C  READ IN INITIAL TIME ONLY          FOLLOWING FOR ALL STATIONS
   12 CONTINUE
      READ 2,NLAP,NPU
      NTOP = NLAP+NP1
      NATAL = NTOP-IX
      DO 13I=NP2,NTOP
      READ 1, PA(I),TA(I),QA(I),COB(I)
      PRINT 1,PA(I),TA(I),QA(I),COB(I)
   13 CONTINUE
      ST4(NP2)=SIG*TA(NP2)**4
      NTOP1=NTOP-1
      TW = 0.
      IF (XIIN.EQ.1..AND.XJIN.EQ.1.) GO TO 19
C     XYY(LEVEV,          VARIABLE IN YY  ,STATION)
      XD1 = XD*(XIIN-1.)
      YD1 =-XD*(XJIN-1.)
      DO 191J=1,6
  184 I = J
  190 DO 18 K=1,NP1
   18 XYY(K,J,2) = YY(K,J  ) -ZE2(K,I)*YD1-ZE1(K,I)*XD1
      IF (J-4) 192,191,191
  192 XYY(IP1,J,2) = XYY(IX,J,2)
  191 CONTINUE
      GO TO 25
   19 DO 20 J=1,6
      DO 20 I=1,NP1
   20 XYY(I,J  ,2)  =    YY(I,J)
C  ALL CARDS READ IN AFTER ALL STATIONS STARTED
C  FOLLOWING AT EACH STATION AT TIME STEP ZERO
   25 IF (NTIME.LT.0) GO TO 1313
  301 IF (ITM.NE.NTIME.OR.IS.GT.1) GO TO 389
      IGET = ITM
      READ 2, NTIME,K
      DO 302 I=1,NP1
  302 READ 1,(VARIN(I,J),J=1,4)
      DO 303 I=1,K
      IF (NVCHS(1).EQ.1) READ 1,BR(I),(R(I,J,1),J=1,4)
      IF (NVCHS(2).EQ.1) READ 1,V3(I),(E(I,J,1),J=1,4)
  303 CONTINUE
      DO 304 I=1,NP1
      T1 = Z(I)
      IF (I.EQ.IX) T1=T1-.00001
      IF (I.EQ.IP1)T1=T1+.00001
      IF (NVCHS(1).NE.1) GO TO 305
      CALL XINEAR (T1,BR,4,K,L,R(1,1,1),GNV(I,1),
     1 R(1,2,1),GNV(I,2),R(1,3,1),GNV(I,3),R(1,4,1),GNV(I,4))
      GXY(I,1) = GNV(I,1)
      GXY(I,7) = GNV(I,2)
      GXY(I,2) = GNV(I,3)
      GXY(I,8) = GNV(I,4)
  305 IF (NVCHS(2).NE.1) GO TO 304
      CALL XINEAR (T1,V3,4,K,L,E(1,1,1),GNV(I,5),
     1  E(1,2,1),GNV(I,6),E(1,3,1),GNV(I,7),E(1,4,1),GNV(I,8))
      GXY(I,3 ) = GNV(I,5)
      GXY(I,9 ) = GNV(I,6)
      GXY(I,4 ) = GNV(I,7)
      GXY(I,10) = GNV(I,8)
  304 CONTINUE
  389 IF (ITM) 1313,1313,500
 1313 CONTINUE
      IRAT = IMARA
      INEW = 10 *IMARA
      INEWC = INEW
C  READ FOR EACH STATION   CLOUDS FROM RAD
C                          THERMAL CONDUCTIVI  IF LAND
C            ANY OTHER VARIABLE REQUIRE FOR A PARTICULAR RUN
C  READ STATION VALUES            FOLLOWING AT STATION START
      READ 2, NTFOR,NCL,NTCUV,IPOI,IGONY,ISSI1,ISSI2
      READ 67,PSFA,XLAM,DEL
      READ 68,                SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV
   68 FORMAT(5E12.5,I12)
   67 FORMAT(8F10.2)
    1 FORMAT(7F10.2)
      PRINT 1111,PSFA,XLAM,DEL,SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV
      IGOGO = IGONY + 3
      IGOG  = IGOGO
      HEIGHT = HEIGHT*100.
      IF(HEIGHT.EQ.0.0) GO TO 313
      DO 34 I=1,IX
      K = IX-I+1
      IF(HEIGHT.LT.Z(K)) GO TO 34
      IHT = K +1
      GO TO 36
   34 CONTINUE
      IHT = 1
      GO TO 36
  313 IHT = IP1
   36 CONTINUE
      DO 30 I=1,NTCUV
      READ  5, ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2
   30 PRINT 5,ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2
      IF (NTFOR.LE.0) NTFOR = 1
      ISTEP(I) = 601
      IF(NCL)114,114,115
C     NUMBER OF CLOUD LAYERS,AMOUNTS AND RAINFALL RATE INPUT
  115 DO 933 I=1,NTFOR
      READ  3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),
     1  L=1,NCL)
      PRINT 3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),
     1  L=1,NCL)
      DO 933 LL=1,NCL
  933 LLCI(I,LL) = LLCI(I,LL)     -IX
  114 NCLI = NCL
      LLCI(1,NCL+1) = 61
      GO TO (1520,1520,1520,1510),IGOGO
 1510 READ 1   , SRS,ROW,CW,XMQ,RADMX
      PRINT 1  ,SRS,ROW,CW,XMQ,RADMX
      READ  1  , (XKT(I),I=1,IM1)
      PRINT 1  , (XKT(I),I=1,IM1)
 1520 CONTINUE
      DO 699I=1,20
      SOU1(I) = 0.
      SOU2(I) = 0.
      IF(I.GT.6) GO TO 699
      SH1(I) = 0.
      SH2(I) = 0.
  699 CONTINUE
      IF(IPOI)700,700,701
  701 READ 2, (ITS1(I),I=1,ISSI1)
      PRINT 2,(ITS1(I),I=1,ISSI1)
      READ 1  , (SOU1(I),I=1,ISSI1)
      PRINT 1  ,(SOU1(I),I=1,ISSI1)
      READ 1  ,(SH1(I),I=1,6)
      PRINT 1  ,(SH1(I),I=1,6)
      IF(IPOI.EQ.1) GO TO 700
      READ 2,  (ITS2(I),I=1,ISSI2)
      PRINT 2, (ITS2(I),I=1,ISSI2)
      READ 1  ,  (SOU2(I),I=1,ISSI2)
      PRINT 1  , (SOU2(I),I=1,ISSI2)
      READ 1  ,(SH2(I),I=1,6)
      PRINT 1  ,(SH2(I),I=1,6)
  700 DO 117  L=NP2,NTOP1
      IF(QA(L+1).LE.0.0) QA(L+1) = 0.001
      T1 = (QA(L)+QA(L+1))/2.*(PA(L)-PA(L+1))/G
      TW = TW + T1
      K=L-IX
      DUW(K) = T1
      COA(K) = .4148239*(PA(L)-PA(L+1))
C     T8 = (COB(K)+COB(K+1))/2.*DZ(L)*1.E-5
C  DZ(L) NOT SET ABOVE THE TOP PREDICTION LEVEL
      T8 = (COB(L)+COB(L+1))/2.*1.E-5  *AR/G*TA(L)/PA(L)*
     1     (PA(L)-PA(L+1))
C   XNO IS THE INFRARED ABSORPTION COEFFICIENT FOR AEROSOLS
      CGA(K) = T8*1.66*XNO
      PAAB(K) = T8*SOAB
      PASA(K) = T8*SOSC
      ST4(L+1)=SIG*(TA(L+1)**4)
      DST4(L) = (ST4(L)+ST4(L+1))*.5
  117 CONTINUE
      DO 23 N=1,JMAX
      DO 23 M=1,IMAX
      XD1 = XD*(M-1)
      YD1 =-XD*(N-1)
      DO 23 I=1,NP1
      T1 = XD1*ZE1(I,1)+YD1*ZE2(I,1)+XYY(I,1,2)
      T2 = XD1*ZE1(I,2)+YD1*ZE2(I,2)+XYY(I,2,2)
      T3 =  T1**2+T2**2
      IF (T3) 23,23,223
  223 T3 = SQRT(T3)
      IF (T3.GT.SAVE)  SAVE = T3
   23 CONTINUE
      TDEL = XD/SAVE
      SAVE = 0.01
      DO 108  I=IY,NX
      T1  =-2.*G*(Z(I+1)-Z(I))
      T2  =AR*(TT2(I)+TT2(I+1))
  108 VAR3(I) = EXP(T1/T2)
      IF (NPU) 101,101,102
  101 PA(IP1)= PSFA
  109 DO 111  I=IY,NX
      PA(I+1)=PA(I)*VAR3(I)
  111 CONTINUE
      GO TO 103
  102 PA(NP1) = PSFA
  110 DO 113 I=IY,NX
      K = NX - I + IY
      PA(K)=VAR3(K)/PA(K+1)
  113 CONTINUE
  103 CONTINUE
      IF (IGONY) 51,51,150
  150 DEL = 0.
      GO TO 52
   51 ROW = 1.
      CW  = .935
      XMQ =1.
      IF (XLAM) 52,4,52
    4 DEL=.055
   52 CONTINUE
   33 XM = MS-1
      YM = NS-1
      XD1 = XD*XM
      YD1 =-XD*YM
      DO 29 J=1,6
  284 I = J
  290 DO 28 K=1,NP1
   28 YY(K,J  ) = XYY(K,J,2) +ZE2(K,I)*YD1+ZE1(K,I)*XD1
      IF (J-4) 291,29,29
  291 YY(IP1,J) = YY(IX,J)
   29 CONTINUE
C     ALL INITIAL DATA SET
      GO TO (797,796,796,795),IGOGO
  795 DO 14 J=1,4
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      DO 14I=1,IX                                                        SDATA275
   14 YY(I,J) = 0.                                                       SDATA276
      GO TO 1114                                                         SDATA277
  797 DO 798 J=1,2                                                       SDATA278
      DO 798 I=1,IX                                                      SDATA279
  798 YY(I,J) = 0.                                                       SDATA280
      GO TO 1114                                                         SDATA281
  796 IQI = 5                                                            SDATA282
      IF(W2(IX).EQ.0.0) IQI =4                                           SDATA283
      DO 141J=IQI,6                                                      SDATA284
      DO 141I=1,IX                                                       SDATA285
  141 YY(I,J) = 0.                                                       SDATA286
      IF(IHT.EQ.1) GO TO 122                                             SDATA287
      IIHT = IHT - 1                                                     SDATA288
      DO 121 I=1,IIHT                                                    SDATA289
      U2(I) = 0.0                                                        SDATA290
  121 V2(I) =0.0                                                         SDATA291
  122 IF(IGONY.EQ.0) GO TO 1114                                          SDATA292
      IF(IANV.GT.1) GO TO 118                                            SDATA293
      DO 119 I=1,IX                                                      SDATA294
  119 V2(I) = 0.0                                                        SDATA295
      GO TO 1114                                                         SDATA296
  118 DO 120 I=1,IX                                                      SDATA297
  120 U2(I) = 0.0                                                        SDATA298
 1114 READ 16, (YY(I,3),I=1,IP1)                                         SDATA299
   16 FORMAT(6E12.4)                                                     SDATA300
      IF(IPOL.EQ.0) GO TO 350                                            SDATA301
      READ 16, (YY(I,5),I=IX,NP1)                                        SDATA302
      DO 351 I=IX,NP1                                                    SDATA303
      YY(I,5) = YY(I,5)/ROA/100.                                         SDATA304
  351 CONTINUE                                                           SDATA305
      IF(IPOL.EQ.1) GO TO 350                                            SDATA306
      READ 16, (YY(I,6),I=IX,NP1)                                        SDATA307
      DO 352 I=IX,NP1                                                    SDATA308
      YY(I,6) = YY(I,6)/ROA/100.                                         SDATA309
  352 CONTINUE                                                           SDATA310
  350 IF(IGONY.EQ.0) GO TO 10                                            SDATA311
      U2(IP1) = 0.                                                       SDATA312
      V2(IP1) = 0.                                                       SDATA313
   10 DO 9I=1,NP1                                                        SDATA314
      TTO(I)=TT2(I)                                                      SDATA315
      TT2(I)=0.                                                          SDATA316
      TT1(I) = TT2(I)                                                    SDATA317
      U1(I) = U2(I)                                                      SDATA318
      V1(I) = V2(I)                                                      SDATA319
      WO(I)=W2(I)                                                        SDATA320
      W2(I)=0.                                                           SDATA321
      W1(I) = W2(I)                                                      SDATA322
      TT3(I) = TT2(I)                                                    SDATA323
      U3(I) = U2(I)                                                      SDATA324
      V3(I) = V2(I)                                                      SDATA325
      W3(I) = W2(I)                                                      SDATA326
      PP21(I) = PP22(I)                                                  SDATA327
      PP11(I) = PP12(I)                                                  SDATA328
      PP13(I) = PP12(I)                                                  SDATA329
      PP23(I) = PP22(I)
    9 CONTINUE
      ICK = ITESTP
      ISTR=0
      LY=1
      C5 = 1.
      C6 = 1.
      GD2 = 0.
      PHI = PHIBOT + XDT1*(JMAX-NS)
      T1= PHI * .017453293
      H= HWEST + (MS-1) * XDT1/COS(T1)
      PHIR = T1
      CPH = COS(PHIR)
      SPH = SIN(PHIR)
      SF = 14.584E-5*SIN(T1)
      DTSF = DT*SF
      C1 = 3.7943/PA(IP1)
      GSF = G/SF
      GFR =GSF/ROW
      DTA = DT
      DTA2 = 2.*DT
      T10 = XLAM*DEL/2.
      DO 720 I=1,NX
      ZDL2(I) = (ZA(I) + T10) **2
  720 CONTINUE
      TK = XK2**2
      DO 725 I=1,IM1
      CKO(I) = TK*ZDL2(I)
  725 CONTINUE
      TK = XK12
      DO 735 I=IP1,NX
      CKO(I) = TK*ZDL2(I)
  735 CONTINUE
      DO 2000I=1,15
 2000 RSUM(I) = 0.
      RANS = 0.
      RABNS = 0.
      RABS = 0.
      CRNS = 0.
      CRS = 0.
      RAA = 0.
      TOUPRA = 0.
      IF(XLAM) 45,99,45
   45 IF(DEL)60,50,60
   50 T6 = Z(IP2)/XLAM
      T6 = ABS(T6)
      B1 = 1./XK1*ALOG(T6)
      T7 = Z(IM1)/XLAM
      T7 = ABS(T7)
   54 B2 = 1./XK1*ALOG(T7)
      GO TO 70
   60 T8 = XLAM/2./PI
      T16=T8**EX2
      T9=SQRT(G)*DEL*T16
      DO 65 I=1,NX
      T10 = -ZA(I)/T8                                                   SDATA385
      CSW(I) = T9*EXP(T10)                                              SDATA386
   65 CONTINUE                                                          SDATA387
      XKU(IP1) = CKO(IP1)*CSW(IP1)                                      SDATA388
      XKT(IP1) = XKU(IP1)                                               SDATA389
      XKU(IM1) = CKO(IM1)*CSW(IM1)                                      SDATA390
      XKT(IM1) = XKU(IM1)                                               SDATA391
   70 CONTINUE                                                          SDATA392
      GO TO 99                                                          SDATA393
  500 CONTINUE                                                          SDATA394
      NVAR1 = 1                                                         SDATA395
      NVAR6 = 6                                                         SDATA396
      DO 585 I = 1,NP1                                                  SDATA397
      U3(I) = 0.                                                        SDATA398
      V3(I) = 0.                                                        SDATA399
      TT3(I) = 0.                                                       SDATA400
      W3(I) = 0.                                                        SDATA401
      PP13(I) = 0.                                                      SDATA402
      PP23(I) = 0.                                                      SDATA403
  585 CONTINUE                                                          SDATA404
C***********************************************************************SDATA405
C**** FLOATING GRID STATIONS ARE ASSIGNED THE FOLLOWING NUMBERS ********SDATA406
C                                                                       SDATA407
C                                    6  4  7                            SDATA408
C                                                                       SDATA409
C                                    1  2  3                            SDATA410
C                                                                       SDATA411
C                                    8  5  9                            SDATA412
C                                                                       SDATA413
C**** WHERE THE COMPUTED GRADIENTS ARE APPLIED AT STATION 2 ************SDATA414
C***********************************************************************SDATA415
      DO 666 I=1,5                                                      SDATA416
      IF(I.EQ.2.OR.I.EQ.3) GO TO 666                                    SDATA417
      DO 666 J=1,12                                                     SDATA418
      ALL(J,I) = 0.                                                     SDATA419
  666 CONTINUE                                                          SDATA420
C  SET DATA FROM RESTART                                                SDATA421
C   COMPUTES THE CENTERED AND UPWIND GRADIENTS                          SDATA422
      IU3 = 3                                                           SDATA423
      IF (MS-2) 511,501,501                                             SDATA424
C  SETS STATION 2   MS=1                                                SDATA425
  511 READ (RDRUM'IS)     (YIN2(I),I=1,NWSYY)                           SDATA426
      DO 600 I=1,12                                                     SDATA427
      ALL(I,2) = YIN3(I)                                                SDATA428
  600 CONTINUE                                                          SDATA429
      SLOPX = ALL(1,2)                                                  SDATA430
      SLOPY = ALL(2,2)                                                  SDATA431
      HEIGHT = ALL(3,2)                                                 SDATA432
      ETA1   = ALL(4,2)                                                 SDATA433
      ETA2   = ALL(5,2)                                                 SDATA434
      XETA2  = ALL(6,2)                                                 SDATA435
      YETA2  = ALL(7,2)                                                 SDATA436
      IHT    =IALL(8,2)                                                 SDATA437
      IANV   =IALL(9,2)                                                 SDATA438
      IGOGO  =IALL(10,2)                                                SDATA439
      IGONY=IGOGO-3                                                     SDATA440
      ETAINX = ALL(11,2)                                                SDATA441
      ETAINY = ALL(12,2)                                                SDATA442
      LOCXYY(2) = -1                                                    SDATA443
      IU3 = 2                                                           SDATA444
      ALL(11,1) = ALL(11,2)                                             SDATA445
      ALL(12,1) = ALL(12,2)                                             SDATA446
C  SETS STATION 3   MS GT 1                                             SDATA447
  501 DO 503 J=NVAR1,NVAR6                                              SDATA448
      DO 503 K=1,NP1                                                    SDATA449
      IF (MS.EQ.1) GO TO 1603                                           SDATA450
      XYY(K,J,1) = XYY(K,J,2)                                           SDATA451
      XYY(K,J,2) = XYY(K,J,3)                                           SDATA452
 1603 YY(K,J)    = XYY(K,J,IU3)                                         SDATA453
  503 CONTINUE                                                          SDATA454
      PP23(NP1) = PP22(NP1)                                             SDATA455
      PP13(NP1) = PP12(NP1)                                             SDATA456
      IF(MS.EQ.1) GO TO 610                                             SDATA457
      DO 604 I=1,12                                                     SDATA458
      IF(I.EQ.8.OR.I.EQ.10) GO TO 1610                                  SDATA459
      ALL(I,1) = ALL(I,2)                                               SDATA460
      ALL(I,2) = ALL(I,3)                                               SDATA461
      GO TO 604                                                         SDATA462
 1610 IALL(I,1) = IALL(I,2)                                             SDATA463
      IALL(I,2) = IALL(I,3)                                             SDATA464
  604 CONTINUE                                                          SDATA465
      SLOPX = ALL(1,2)                                                  SDATA466
      SLOPY = ALL(2,2)                                                  SDATA467
      HEIGHT = ALL(3,2)                                                 SDATA468
      ETA1   = ALL(4,2)                                                 SDATA469
      ETA2   = ALL(5,2)                                                 SDATA470
      XETA2  = ALL(6,2)                                                 SDATA471
      YETA2  = ALL(7,2)                                                 SDATA472
      IHT    =IALL(8,2)                                                 SDATA473
      IANV   =IALL(9,2)                                                 SDATA474
      IGOGO  =IALL(10,2)                                                SDATA475
      IGONY=IGOGO-3                                                     SDATA476
      ETAINX = ALL(11,2)                                                SDATA477
      ETAINY = ALL(12,2)                                                SDATA478
  610 LOCXYY(1) = LOCXYY(2)                                             SDATA479
      LOCXYY(2) = IS                                                    SDATA480
  515 IF (MS-IMAX) 560,561,561                                          SDATA481
  560 LOCXYY(3) = IS+1                                                  SDATA482
      READ (RDRUM'IS+1)   (YIN3(I),I=1,NWSYY)                           SDATA483
      DO 601 I=1,12                                                     SDATA484
      ALL(I,3) = YIN4(I)                                                SDATA485
  601 CONTINUE                                                          SDATA486
      GO TO 562                                                         SDATA487
  561 LOCXYY(3) = -1                                                    SDATA488
C   STATIONS 1-3 SET   NOW SET 4-5                                      SDATA489
  562 IF (NS-1) 563,563,564                                             SDATA490
  563 LOCXYY(4) = -1                                                    SDATA491
      ALL(11,4) = ALL(11,2)                                             SDATA492
      ALL(12,4) = ALL(12,2)                                             SDATA493
      GO TO 565                                                         SDATA494
  564 LOCXYY(4) = IS-IMAX                                                SDATA495
      READ (RDRUM'LOCXYY(4)) (YIN4(I),I=1,NWSYY)                         SDATA496
      DO 602 I=1,12                                                      SDATA497
      ALL(I,4) = YIN5(I)                                                 SDATA498
  602 CONTINUE                                                           SDATA499
  565 IF (NS-JMAX) 566,567,567                                           SDATA500
  566 LOCXYY(5) = IS+IMAX                                                SDATA501
      READ (RDRUM'LOCXYY(5)) (YIN5(I),I=1,NWSYY)                         SDATA502
      DO 603 L=1,12                                                      SDATA503
      K = NWSYY - 12 + L                                                 SDATA504
      ALL(L,5) = YIN5(K)                                                 SDATA505
  603 CONTINUE                                                           SDATA506
      GO TO 568                                                          SDATA507
  567 LOCXYY(5) = -1                                                     SDATA508
      ALL(11,5) = ALL(11,2)                                              SDATA509
      ALL(12,5) = ALL(12,2)                                              SDATA510
C  ENTIRE XYY NOW SET FOR UPWIND                                         SDATA511
  568 CONTINUE                                                           SDATA512
  619 SQ2 = SQRT(2.)                                                     SDATA513
C   UPWIND/CENTERED DIFFERENCE ROUTINE FOR UP TO 6 VARIABLES             SDATA514
      XMD = 1. /XD                                                       SDATA515
      DO 649 I=1,12                                                      SDATA516
      DO 649 J=1,30                                                      SDATA517
      PGXY(J,I) = 0.                                                     SDATA518
      CGXY(J,I) = 0.                                                     SDATA519
  649 CONTINUE                                                           SDATA520
      GO TO (620,642,642,620),IGOGO                                      SDATA521
  642 II = 6                                                             SDATA522
      IJ = 1                                                             SDATA523
      IK = 3                                                             SDATA524
      IL = 11                                                            SDATA525
      DO 644 KK = 1,2                                                    SDATA526
      IF(LOCXYY(IJ).LT.0.OR.LOCXYY(IK).LT.0) GO TO 645                   SDATA527
      ALL(II,2) = (ALL(5,IK) - ALL(5,IJ))*XMD/2.                         SDATA528
      GO TO 615                                                          SDATA529
  645 IF(LOCXYY(IJ).LT.0.AND.LOCXYY(IK).LT.0) GO TO 646                  SDATA530
      IF(LOCXYY(IJ).LT.0) GO TO 647                                      SDATA531
      IF(LOCXYY(IK).LT.0) GO TO 648                                      SDATA532
  646 ALL(II,2) =(ALL(IL,IK) - ALL(IL,IJ))*XMD/2.                        SDATA533
      GO TO 615                                                          SDATA534
  647 ALL(II,2) = (ALL(5,IK) - ALL(IL,IJ))*XMD/2.                        SDATA535
      GO TO 615                                                          SDATA536
  648 ALL(II,2) = (ALL(IL,IK) - ALL(5,IJ))*XMD/2.                        SDATA537
  615 II = 7                                                             SDATA538
      IJ = 5                                                             SDATA539
      IK = 4                                                             SDATA540
      IL = 12                                                            SDATA541
  644 CONTINUE                                                           SDATA542
      XETA2 = ALL(6,2)                                                   SDATA543
      YETA2 = ALL(7,2)                                                   SDATA544
      IF(IGONY.EQ.-1) GO TO 620                                          SDATA545
  641 I2IHT = IHT                                                        SDATA546
      I3IHT = IHT                                                        SDATA547
      DO 607 J=1,3                                                       SDATA548
      IIHT = IALL(8,J)                                                   SDATA549
      IF(IIHT.GT.I2IHT) I2IHT= IALL(8,J)                                SDATA550
  607 CONTINUE                                                          SDATA551
      DO 608 J=4,5                                                      SDATA552
      IIHT = IALL(8,J)                                                  SDATA553
      IF(IIHT.GT.I3IHT) I3IHT = IALL(8,J)                               SDATA554
  608 CONTINUE                                                          SDATA555
  620 DO 599 IJXY=1,2                                                   SDATA556
      IXY =(IJXY-1)*6                                                   SDATA557
      IF (IJXY-1) 1501,1501,1502                                        SDATA558
 1501 IF (LOCXYY(3)) 521,521,522                                        SDATA559
  521 IU3 = 2                                                           SDATA560
      GO TO 523                                                         SDATA561
  522 IU3 = 3                                                           SDATA562
  523 IF (LOCXYY(1)) 524,524,525                                        SDATA563
  524 IU1 = 2                                                           SDATA564
      GO TO 1505                                                        SDATA565
  525 IU1 = 1                                                           SDATA566
      GO TO 1505                                                        SDATA567
 1502 IF (LOCXYY(4)) 1521,1521,1522                                     SDATA568
 1521 IU3 = 2                                                           SDATA569
      GO TO 2521                                                        SDATA570
 1522 IU3 = 4                                                           SDATA571
 2521 IF (LOCXYY(5)) 1524,1524,1525                                     SDATA572
 1524 IU1 = 2                                                           SDATA573
      GO TO 1505                                                        SDATA574
 1525 IU1 = 5                                                           SDATA575
C  UPWIND DIFFERENCE IN X(IJXY=1)/Y(IJXY=2) DIRECTION                   SDATA576
 1505 IKI = 1                                                           SDATA577
      IF(IGONY.EQ.1) IKI=IP2                                            SDATA578
      DO 550  LR=IKI,NP1                                                SDATA579
      IF(XYY(LR,IJXY,2)) 531,532,536                                    SDATA580
C ABOVE CHECKS U/V  NOW INFLOW CONDITION CHECK                          SDATA581
  531 IF (IU3-2) 435,532,435                                            SDATA582
  435 IU3U = IU3                                                        SDATA583
      IU2 = 2                                                           SDATA584
      GO TO 534                                                         SDATA585
C  UPWIND IS INFLOW--SET TO INPUT                                       SDATA586
  532 DO 533 J=NVAR1,NVAR6                                              SDATA587
      K = IXY+J                                                         SDATA588
  533 PGXY(LR,K) = GXY(LR,K)                                            SDATA589
      GO TO 540                                                         SDATA590
  536 IF (IU1-2) 537,532,538                                            SDATA591
  537 IU3U = 2                                                          SDATA592
      IU2 = 1                                                           SDATA593
      GO TO 534                                                         SDATA594
  538 IU3U = 2                                                          SDATA595
      IU2  = 5                                                          SDATA596
C  UPWIND DIFFERENCE                                                    SDATA597
  534 DO 535 J=NVAR1,NVAR6                                              SDATA598
      K = IXY+J                                                         SDATA599
      PGXY(LR,K) = XMD*(XYY(LR,J,IU3U)-XYY(LR,J,IU2))                   SDATA600
  535 CONTINUE                                                          SDATA601
C    C COMPUTE CENTERED DIFFERENCE.                                     SDATA602
  540 DO 547 J=NVAR1,NVAR6                                              SDATA603
      K = IXY+J                                                         SDATA604
      CGXY(LR,K) =((XYY(LR,J,IU3) - XYY(LR,J,2))                        SDATA605
     1  +(XYY(LR,J,2)- XYY(LR,J,IU1)))*XMD/2.                           SDATA606
      IF(IGONY.LT.0) GO TO 547                                          SDATA607
      IF (IU3.EQ.2.OR .IU1.EQ.2) CGXY(LR,K) =PGXY(LR,K)                 SDATA608
  547 CONTINUE                                                          SDATA609
  550 CONTINUE                                                          SDATA610
  599 CONTINUE                                                          SDATA611
   99 RETURN                                                            SDATA612
    2 FORMAT ( 14I5)                                                    SDATA613
    3 FORMAT(I4,I2,F6.2,5(I3,F5.1,F4.0))                                SDATA614
    5 FORMAT(I5,4F10.2,2A4)                                             SDATA615
 1111 FORMAT(' SFC P =',F10.4/' LAMBDA =',F10.4/' DELTA =',F10.4/' SLOPXSDATA616
     1=',F10.4/' SLOPY =',F10.4/' HEIGHT(+)/DEPTH(-) =',F10.4/' THE INPUSDATA617
     2T SURFACE HEIGHT FOR OPEN WATER BOUNDARIES'/' INPUT X-ETA =',F10.4SDATA618
     3/' INPUT Y-ETA =',F10.4/' IANV =',I10//)                          SDATA619
      END                                                               SDATA620
      SUBROUTINE INFRAI(WA ,COA,CGA,KA,NTOP)                            INFRA000
C    CALL INFRAI PRIOR TO CALLING INFRA  WHEN USING A GIVEN DELTA EMISSIVINFRA001
C    PATH LENGTHS ARE   WA  FOR WATER VAPOR                             INFRA002
C                       COA  FOR CARBORN DIOXIDE                        INFRA003
C                       CGA FOR AEROSOLS                                INFRA004
      DIMENSION WA(1),COA(1),CGA(1),DTAUF(25,16),TOTAU(16)              INFRA005
      DIMENSION STB(1),ST4(1),LLC(1),EC(1),DTT(1),RA(1),RB(1)           INFRA006
      DIMENSION DT(20),PA(1)                                            INFRA007
C  TO STORE VALUES OF EMISSIVITY FOR KA LEVELS                          INFRA008
C  WITH NTOP ATMOSPHERIC LAYERS                                         INFRA009
      AW = 980./240.                                                    INFRA010
      MM1 = NTOP-1                                                      INFRA011
      KSAV = MIN0(KA,16)                                                INFRA012
      DO 70 LR=1,KSAV                                                   INFRA013
      KUHN = 1                                                          INFRA014
      UW = 0.                                                           INFRA015
      UC = 0.                                                           INFRA016
      TP = 1.                                                           INFRA017
      UAA= 0.                                                           INFRA018
      DEP= 0.                                                           INFRA019
      DO135 I=LR,MM1                                                    INFRA020
      UW = UW+WA(I)                                                     INFRA021
      UC = UC+COA(I)                                                    INFRA022
      UAA= UAA+CGA(I)                                                   INFRA023
      T1 = -.32*UC**.4                                                  INFRA024
      TC =(1.-EXP(T1))*.185                                             INFRA025
      IF (UAA) 136,136,137                                              INFRA026
  137 TP = EXP(-UAA)                                                    INFRA027
  136 CALL XUHN(UW,EW,KUHN)                                             INFRA028
      T1 = EW+TC                                                        INFRA029
      TT = (1.-T1)*TP                                                   INFRA030
      DEW = 1.-TT                                                       INFRA031
      DTAUF(I,LR) = DEW-DEP                                             INFRA032
      DEP = DEW                                                         INFRA033
  135 CONTINUE                                                          INFRA034
      IF (LR-1) 70,70,245                                               INFRA035
  245 KUHN = 1                                                          INFRA036
      UC = 0.                                                           INFRA037
      UW = 0.                                                           INFRA038
      UAA= 0.                                                           INFRA039
      I1 = LR-1                                                         INFRA040
      TP = 1.                                                           INFRA041
      DEP = 0.                                                          INFRA042
      DO155 I=1,I1                                                      INFRA043
      K = LR-I                                                          INFRA044
      UW = WA(K)+UW                                                     INFRA045
      UC = COA(K)+UC                                                    INFRA046
      UAA= CGA(K)+UAA                                                   INFRA047
      TC = 1.-EXP(-.32*UC**.4)                                          INFRA048
      CALL XUHN (UW,EW,KUHN)                                            INFRA049
      IF (UAA) 154,154,153                                              INFRA050
  153 TP = EXP(-UAA)                                                    INFRA051
  154 T1 = EW+TC    *.185                                               INFRA052
      TT = (1.-T1)*TP                                                   INFRA053
      DEW = 1.-TT                                                       INFRA054
      SUBROUTINE SOLARI( P ,TW,CSZI)TE)
      DIMENSION DUW(1),PA(1),PASA(1),PAAB(1),DTDU(1),STHE(25)
      ATWA(AP,AC) = SQRT((.000949*AP+.051)/AC)
      CO3 = 980./ 239.
      XIO = 1.95/60.
      COSZ = CSZI
      IF (COSZ-.17365) 11,12,12
   11 VALUE = COSZ/.17365
      COSZ = .17365
      GO TO 13
   12 VALUE = 1.
   13 TAU1 = 1.041-0.16*ATWA(P,COSZ)
      TAU1 = .5+.5*TAU1
      TAU2 =  .077*(TW/COSZ)**.3
      TE = XIO*COSZ*VALUE*(TAU1-TAU2)
      TE = AMAX1(TE,0.)
      UT = TW
      RETURN
      ENTRY SOLHEA(NLAY,XIN5,PA,DUW,PASA,PAAB,DTDT,TOPRA)
      CO1 = XIO*2.4674E-5*VALUE
      CO2 = 7.55E-4*VALUE
      TAU1 = DTDT(2)
      TOPRA = 0.
      DO 30 K=1,NLAY
      I = NLAY+1-K
      P3 =(PA(I+1)+PA(I))/2.
      DIZ = CO1*(PA(I)-PA(I+1))/ATWA(P3,COSZ)
      DIW  = CO2/(UT/COSZ)**.7*DUW(I)*TAU1
      UT = UT+DUW(I)
      DIPA = 0.
      DIPS = 0.
      IF (PAAB(I).GT.0.) DIPA=XIN5*(1.-1./EXP(PAAB(I)/COSZ))
      XIN6 = XIN5-DIPA
      XIN6 = AMAX1(XIN6,0.)
      IF (PASA(I).GT.0.) DIPS=XIN6*(1.-1./EXP(PASA(I)/COSZ      ))
      STHE(I) = CO3*(DIW+DIPA)/(PA(I)-PA(I+1)   )
      XIN5 = XIN5-(DIZ+DIW+DIPA+DIPS)
      TOPRA = TOPRA+DIPS+DIZ
      XIN5 = AMAX1(XIN5,0.)
   30 CONTINUE
      DO 80 I=2,NLAY
      T1 = (PA(I)-PA(I-1))/(PA(I+1)-PA(I-1))
      [illegible]DT(I) = STHE(I-1)+T1*(STHE(I)-STHE(I-1))
   80 CONTINUE
      RETURN
      END
```

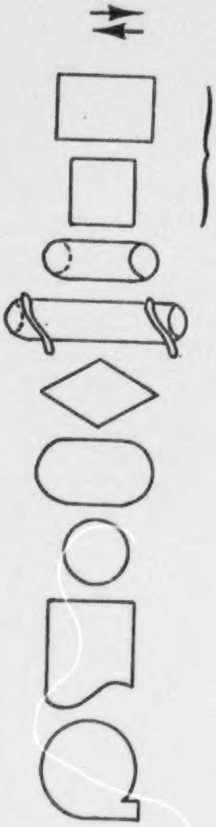
The following named subprograms used in the RIGID LID model can be found in the FREE SURFACE model listing of this report.

Program Name	Page Number
SOLAR2	111, 112
LINEAR	115
XUHN	116
TRANS	117
FILES	118

3.0 MAIN PROGRAM: FREE SURFACE Version

This section contains a flow diagram (Figure 4) which shows the operation in the numerical model MAIN Program, FREE SURFACE version, for the atmosphere-water planetary boundary layer with land option and pollutants. Following the flow diagram is its accompanying program listing.

The symbols used in the diagram are, for the most part, those which have become standard flow chart symbols. The explanation of the symbols is as follows:



Flow direction.

Program steps.

Subroutine call.

Disk (temporary storage).

Switch disk (temporary storage).

Decision on symbol contents.

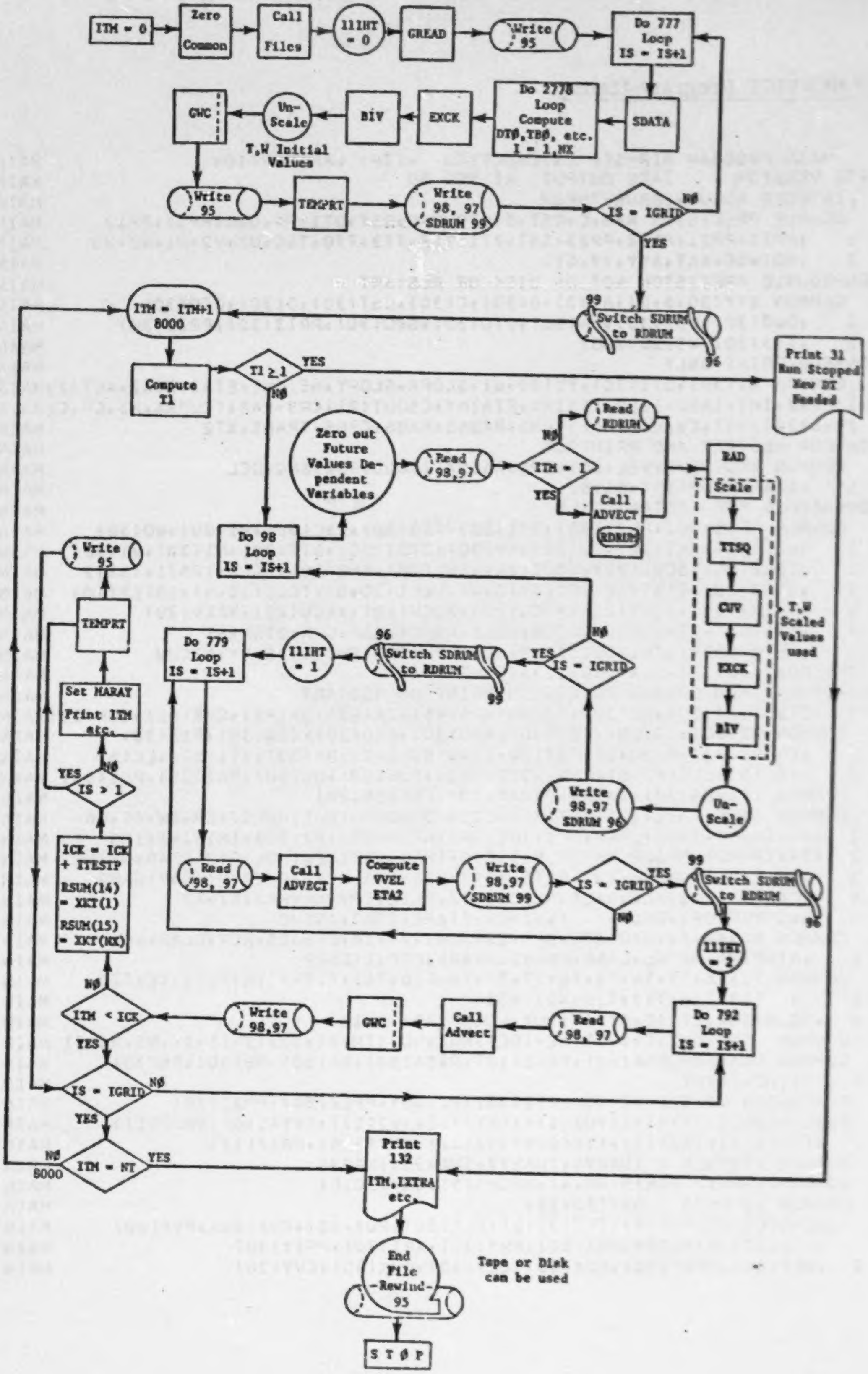
Multiple entrance branch.

Contents self-explained.

Printed (output).

Magnetic tape (output).

Figure 3. Flow Diagram MAIN Program, FREE SURFACE Version: Air-sea-land interaction model.→


ITM = 0
Zero Common
Call Files
I1INT = 0
GREAD
Write 95
Do 777 Loop IS = IS+1
SDATA
Do 2778 Loop Compute DTØ,TBØ, etc. I = 1,NX
EXCK
BIV
Un-Scale
GWC
T,W Initial Values
Write 95
TEMPRT
Write 98, 97 SDRUM 99
IS = IGRID
NØ
YES
ITM = ITM+1 8000
99
Switch SDRUM to RDRUM
96
Compute T1
T1 ≥ 1
YES
NØ
Print 31 Run Stopped New DT Needed
Zero out Future Values Dependent Variables
Read 98,97
ITM = 1
NØ
Read RDRUM
YES
Call ADVECT
RDRUM
RAD Scale
TTSQ
CUV
EXCK
BIV
T,W Scaled Values used
Un-Scale
Write 98,97 SDRUM 96
Do 98 Loop IS = IS+1
NØ
IS = IGRID
YES
96
Switch SDRUM to RDRUM
99
I1INT = 1
Do 779 Loop IS = IS+1
Read 98, 97
Call ADVECT
Compute VVEL ETA2
Write 98,97 SDRUM 99
IS = IGRID
YES
NØ
99
Switch SDRUM to RDRUM
96
I1INT = 2
Do 792 Loop IS = IS+1
Read 98, 97
Call Advect
GWC
Write 98,97
ITM < ICK
NØ
YES
ICK = ICK + ITESTP
RSUM(14) = XKT(1)
RSUM(15) = XKT(NX)
IS > 1
YES
NØ
Set HARAY Print ITM etc.
TEMPRT
Write 95
IS = IGRID
NØ
YES
ITM = NT
NØ
8000
YES
Print 132 ITM,IXTRA etc.
End File -Rewind- 95
STØP
Tape or Disk can be used

FREE SERVICE Program Listing

```
C      MAIN PROGRAM AIR-SEA INTERACTION  WITH  LAND OPTION
C  1972 VERSION     TAPE OUTPUT  AT YOU GO
      INTEGER RDRUM,SDRUM,TDRUM
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
     2   ,WO,WSC,XKT,XYY,YY,GTO
COMMON-DOUBLE PRECISION NOT ON DISK OR RESTART
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
     2   ,TT3(30),W3(30),SST
COMMON-FOR PRINT ONLY
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
COMMON-FOR RESTART AND PRINTOUT
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2
COMMON-NEEDED FOR RESTART ONLY
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
     5   ,NXN(10),TTW,DECL,COCOB,DELZ,NTFCR,GSF,GFR,DTSF,SF
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT
COMMON-OTHER THAN DOUBLE PRECISION-PRINT OR RESTART
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
     2    ,  T13,T14,T15,T16,XD1,YD1
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
     1 , I1IHT,I4IHT
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)
      COMMON /GRDNTS / GXY(30,12)
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)
     3   ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)
     4   ,CP2X(30),CP2Y(30)
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))
C   UNITS 99,96 FOR YY TO STORE FOR COMPUTATION OF GRADIENTS--DIRECT ACC
C   UNIT  98  FOR RESTART VARIABLES -- DIRECT ACCESS
C   UNIT  95  STORAGE FILE FOR PRINT -- TAPE OR DISK SEQUENTIAL
      DOUBLE PRECISION XT1,XTIME
      DIMENSION ZEROCM(2)     ,YIN(1)
      EQUIVALENCE (ZEROCM(1),XYY(1,1,1))  , (U2(1),YIN(1))
      DO 555 I=1,6989
  555 ZEROCM(I) = 0.
      CALL FILES
      SDRUM = 99
      RDRUM = 96
      NWSYY = 180*2 + 12
      DELZ = 0.0
C     TIMES 2 FOR DOUBLE PRECISION ONLY
      IXTRA = 1
      NCR = 1717
      NCR1 = 753
      NCS =  594
      TDEL = 0.
      IK = 0
C     COMPUTE GRADIENTS   AND READ IN DATA FOR THE GRID
      CALL GREAD
      I = 0
      DO 702 J=1,20
      ITIMES(J) = I
  702 I = I+ITESTP
      ITM = 0
      IF (ITIMES(20).LT.NT) GO TO 80
      NSTART = 0
C     INDIVIDUAL STATION PREDICTION FILE 1
      XDT1 = XD/110.8 * 1.E-5
      SAVE = 0.01
      U3(1) = NCS
      U3(2) = JMAX
      U3(3)= IMAX
      U3(4) = IPOL+11
      U3(5) = NP1
      U3(6) = IX
      U3(7) = DT
      DO 703 I=1,20
  703 U3(I+7) = ITIMES(I)
      U3(28) = XD * 1.E-5
      WRITE (95    ) (Z(I),I=1,NCS)
      DO 777 NS=1,JMAX
      DO 777 MS=1,IMAX
      IS = (NS-1)*IMAX + MS
      CALL SDATA
      DO 2778 I=1,NX
      DTO(I)=TTO(I+1)-TTO(I)
      TBO(I)=(TTO(I+1)+TTO(I))/2.
      WBO(I)=(WO(I+1)+WO(I))/2.
      IF(I-IX) 888,2778,888
  888 DWO(I) = WO(I+1)-WO(I)
      GTO(I)=DTO(I)/DZ(I)
      GWO(I)=DWO(I)/DZ(I)
 2778 CONTINUE
      H3 = 0.
C     INEWC = INEW
      IRAT = IMARA
   35 CALL EXCK
      H = H * .017453293
      RSUM(15) = XKT(NX)
      RSUM(14) = XKT(1)
   40 CALL BIV
      DO3101  I=1,NP1
      TSC(I)=TT2(I)
      WSC(I)=W2(I)
C     COMPUTE UNSCALED T AND W FOR GWC,RAD
      TT2(I)=TT2(I)+TTO(I)
 3101 W2(I)=W2(I)+WO(I)
   45 CALL GWC
C     STORE INITIAL TIME STEP DATA FOR ALL STATIONS FOR PRINT FILE 3
      IF (IS.GT.1) GO TO 46
      MARAY(IXTRA) = MARAY(IXTRA)+1
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)
   46 WRITE (95) (RI(I),I=1,NCS)
      CALL TEMPRT
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO
      WRITE (98'IS) ( RI(I),I=1,NCR)
      WRITE(97'IS) (NXN(I),I=1,NCR1)
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)
  777 CONTINUE
      ICK = ITESTP
C     SWITCH FILE UNITS  FOR ADVECT READ
      I = RDRUM
      RDRUM = SDRUM
      SDRUM = I
 8000 ITM = ITM + 1
      I1IHT = 0
      T1 = TDEL /(1.424214*DT)
      PRINT 335,ITM,DT,T1
      IF (T1-1.)1112,1112,336
 1112 PRINT 31
      GO TO 80
  336 NU1X =  1
```

```
      IF(ITM+NU1X.GT.NT)NU1X = NT-ITM
      IF(NTIME.GT.0.AND.ITM+NU1X.GT.NTIME)NU1X = NTIME-ITM
      NUX = NSTART + NU1X
       IF(ITM.NE.2) GO TO 49
   51 DTA = 2.*DTA
      DTA2 = 2.*DTA2
      C5 = 1.5
      C6 = 2.
      GD2 = .5
      LY=2
   49 NU = NUX
   41 DO 98 NS=1,JMAX
      DO 98 MS=1,IMAX
      IS = (NS-1) * IMAX + MS
      DO 585 I = 1,NP1
      U3(I) = 0.
      V3(I) = 0.
      TT3(I) = 0.
      W3(I) = 0.
      PP13(I) = 0.
      PP23(I) = 0.
  585 CONTINUE
C    READ FILE 1 FOR RESTART
       READ (98'IS) ( RI(I),I=1,NCR)
       READ(97'IS) (NXN(I),I=1,NCR1)
      IF(ITM.EQ.2) GD2 = .5
      IF(ITM.EQ.1) CALL ADVECT
      IF(ITM.EQ.1) GO TO 47
      READ(RDRUM'IS) (YIN(I),I=1,NWSYY)
   47 IF (NTIME.LT.0.OR.IGET.NE.ITM) GO TO 319
      XM = MS
      YM = NS
      XD1 = XD*(XIIN-XM)
      YD1 =-XD*(XJIN-YM)
      XT1= NTIME-IGET
      XTIME = 1./XT1
      DO 315 I=1,NP1
      IF (NVCHS(1).NE.1)  GO TO 312
C  COMPUTE NEW INPUT U3,V3
      U3(I)   = VARIN(I,1)-GNV(I,2)*YD1-GNV(I,1)*XD1
      V3(I)   = VARIN(I,2)-GNV(I,4)*YD1-GNV(I,3)*XD1
      U1(I) = U2(I)-XTIME*(U3(I)-U2(I))
      V1(I) = V2(I)-XTIME*(V3(I)-V2(I))
  312 IF (NVCHS(2).NE.1) GO TO 315
      TT3(I) = VARIN(I,3)-GNV(I,6)*YD1-GNV(I,5)*XD1-TTO(I)
      W3 (I) = VARIN(I,4)-GNV(I,8)*YD1-GNV(I,7)*XD1-WO(I)
      TT1(I)= TT2(I)-XTIME*(TT3(I)-TT2(I))
      W1 (I)= W2 (I)-XTIME*(W3 (I)-W2(I))
  315 CONTINUE
  319 DO 2000 I=1,NX
      DTO(I)=TTO(I+1)-TTO(I)
      TBO(I)=(TTO(I+1)+TTO(I))/2.
      WBO(I)=(WO(I+1)+WO(I))/2.
      IF(I-IX)88,2000,88
   88 DWO(I) = WO(I+1)-WO(I)
```

```
      GTO(I)=DTO(I)/DZ(I)
      GWO(I)=DWO(I)/DZ(I)
 2000 CONTINUE
      H3 = 0.
C     INEWC = INEW
      IRAT = IMARA
      IF(IGONY.EQ.1) DELZ=0.0
      IF(NVCHS(4).NE.1) CALL RAD
      CALL TTSQ
      IF (NTIME.LT.0) GO TO 117
      DO 116I=1,NP1
      IF (NVCHS(1).NE.1) GO TO 114
      U3(I) = 2.*U2(I) - U1(I)
      V3(I) = 2.*V2(I) - V1(I)
  114 IF(NVCHS(2).NE.1)GO TO 116
      W3(I) =  2.*W2(I)-W1(I)
      TT3(I) = 2.*TT2(I)-TT1(I)
  116 CONTINUE
      IF (NVCHS(1).EQ.1)  GO TO 52
  117 GO TO (112,111,111,112),IGOGO
  111 I1 = 1
      II=2
      IT=IM2
      I2=IM3
      I3=IM1
  129 I5 = IT -    IHT + 1
      IF(  IHT.GT.2) GO TO 131
      I5 = IM3
      I1 = 1
      II = 2
  131 CALL CUV
      IF(IGONY.EQ.0) GO TO 121
  113 IF(IANV.GT.1) GO TO 118
      DO 119 I=IHT,IX
      V3(I) = 0.0
  119 CONTINUE
      GO TO 112
  118 DO 120 I=IHT,IX
      U3(I) = 0.0
  120 CONTINUE
      GO TO 112
  121 IF(IHT.EQ.1) GO TO 112
      IF(I2IHT.LE.IHT) GO TO 123
      IIHT = I2IHT-1
      DO 124 I= IHT, IIHT
  124 U3(I) = 0.0
  123 IF(I3IHT.LE.IHT)GO TO 112
      IIHT = I3IHT-1
      DO 125 I= IHT, IIHT
  125 V3(I)= 0.0
  112 I1 = IP1
      II=IP2
      IT=NM1
      I2=NM2
      I3=NX
      I5=IA
      CALL CUV
   52 CONTINUE
      DO 54 I=1,NP1
      TT1(I) = TT2(I)
      U1(I) = U2(I)
      V1(I) = V2(I)
      W1(I) = W2(I)
      TT2(I) = TT3(I)
      U2(I) = U3(I)
      V2(I) = V3(I)
      W2(I) = W3(I)
      PP11(I) = PP12(I)
      PP21(I) = PP22(I)
      PP12(I) = PP13(I)
      PP22(I) = PP23(I)
   54 CONTINUE
      IF(NVCHS(4).EQ.1) XT2 = TT3(IX)
      TT2(IX) = XT2
      TT2(IP1) = XT2
      CALL EXCK
      CALL BIV
  371 DO3100  I=1,NP1
      TSC(I)=TT2(I)
      WSC(I)=W2(I)
C     COMPUTE UNSCALED T AND W FOR GWC,RAD
      TT2(I)=TT2(I)+TTO(I)
 3100 W2(I)=W2(I)+WO(I)
C     STORING COMPUTED VALUES ON DRUM FOR RESTART OF EACH GRID STATION A
      WRITE (98'IS) ( RI(I),I=1,NCR)
      WRITE(97'IS) (NXN(I),I=1,NCR1)
      DO 59 I=1,NP1
      T1 = U2(I)**2+V2(I)**2
      IF (T1) 59,59,159
  159 T1 = SQRT(T1)
      IF (T1.GT.SAVE)  SAVE = T1
   59 CONTINUE
      TDEL = XD/SAVE
C   WRITE YY ON DISK USING DIRECT ACCESS
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)
   98 CONTINUE
C   SWITCH FILE UNITS FOR RESTART
      I = RDRUM
      RDRUM = SDRUM
      SDRUM = I
      I1IHT = 1
      DO 779 NS=1,JMAX
      DO 779 MS=1,IMAX
      IS = (NS-1)*IMAX + MS
       READ (98'IS) ( RI(I),I=1,NCR)
       READ(97'IS) (NXN(I),I=1,NCR1)
      CALL ADVECT
  857 IF(IGONY.GT.0) GO TO 202
      IF(IHT.GT.1) GO TO 201
      SUM2 = (CUX(IX)+CVY(IX))*(DZ(IM1)/2.)
      DO 209 I=2,IX
      K=IX-I+1
      SUM2 = SUM2 + (CUX(K)+CVY(K))*(DZ(K-1)+DZ(K))/2.
  209 VVEL(K) = SUM2
      VVEL(IX)=0.
      IF(ITM.GT.1) GO TO 202
      ETA2 = 0.
      DELZ = 0.
      SLOPX= 0.
      SLOPY= 0.
      GO TO 202
  201 DO 267 I=1,IX
  267 VVEL(I) = 0.0
      SUM1 = 0.
      IIHT = IHT
      IF(IGONY.EQ.-2) IIHT = 2
      DO 200 K=IIHT,IM1
      SUM1 = SUM1 - (CUX(K) + CVY(K))*(DZ(K-1) + DZ(K))/2.
      VVEL(K) = SUM1
  200 CONTINUE
      VVEL(IX) = SUM1 - (CUX(IX) + CVY(IX))*(DZ(IM1)/2.)
      VVEL(IP1) = VVEL(IX)
      ETA2 = ETA1 + VVEL(IX)*DT
      DELZ = ETA2 - ETA1
      ETA1 = ETA2
      IF(ABS(ETA2).GT.500..AND .IGOGO.NE.1) GO TO 206
      GO TO 205
  206 PRINT 207,ETA2                       ,DELZ,VVEL(IX),ITM,IS,IGOGO
  207 FORMAT(1X,'THE WATER SURFACE ELEVATION ETA2 IS',F12.3,/
     1' DELZ = ',F12.3
     2/' VVEL(IX) = ',F12.3/' ITM = ',I10/' IS = ',I10/' IGOGO = ',I10)
      GO TO 99
  205 SUM1 = VVEL(IP1)
      DO 208 I=IP2,NP1
      SUM1 = SUM1 - (CUX(I) + CVY(I))*(DZ(I-1) + DZ(I))/2.
      VVEL(I) = SUM1
  208 CONTINUE
      VVEL(NX) = SUM1 - (CUX(NX) + CVY(NX))*(DZ(NP1)/2.)
      GO TO 50
  202 VVEL(IP1) = 0.0
      VVEL(IP2) =                                   - (CUX(IP2)+ CVY(IP2))*
     1((DZ(IP1) + DZ(IP2))/2.)
      SUM1 = VVEL(IP2)
      DO 203 K=IP3,NP1
      SUM1 = SUM1 - (CUX(K) + CVY(K))*((DZ(K-1) + DZ(K))/2.)
      VVEL(K) = SUM1
  203 CONTINUE
      VVEL(NX) = SUM1 - (CUX(NX)+ CVY(NX))*(DZ(NP1)/2.)
   50 WRITE (98'IS) ( RI(I),I=1,NCR)
      WRITE(97'IS) (NXN(I),I=1,NCR1)
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)
  779 CONTINUE
C     SWITCH FILE UNITS  FOR ADVECT READ
      I = RDRUM
      RDRUM = SDRUM
      SDRUM = I
      I1IHT = 2
      DO 792 NS=1,JMAX
      DO 792 MS=1,IMAX
      IS = (NS-1)*IMAX + MS
       READ (98'IS) ( RI(I),I=1,NCR)
       READ(97'IS) (NXN(I),I=1,NCR1)
      CALL ADVECT
      CALL GWC
      WRITE (98'IS) ( RI(I),I=1,NCR)
      WRITE(97'IS) (NXN(I),I=1,NCR1)
   65 IF(ITM-ICK)792,70,70
   70 RSUM(14) = XKT(1)
      RSUM(15) = XKT(NX)
      IF (IS.GT.1) GO TO 701
      MARAY(IXTRA) = MARAY(IXTRA)+1
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)
  701 CALL TEMPRT
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO
  101 FORMAT(//'  ETA2 =',E18.8,/'  DELZ =',E18.8,/'  XETA2 =',E18.8,/'
     1 YETA2 =',E18.8,/'  CU(IX) =',E18.8,/'  CV(IX) =',E18.8,/'  IHT ='
     2,I10,/'  IGOGO =',I10)
      WRITE (95) (RI(I),I=1,NCS)
  792 CONTINUE
      IF(ITM-ICK) 793,7000,7000
 7000 ICK = ICK + ITESTP
  793 IF(MARAY(IXTRA).NE.0) IXTRA = IXTRA + 1
      NSTART = NU
   94 IF(ITM.EQ.NT) GO TO 80
      GO TO 8000
   80 PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)
      END FILE 95
      REWIND 95
   99 STOP
   31 FORMAT ('1RUN STOPPED--NEW DT NEEDED')
  132 FORMAT ('1TIME STEP STARTING = ',I5,' VALUES IN MARAY =',I5/' MARA
     1Y IS',20I4)
  335 FORMAT (' ITM',I6,',DT',E12.4,',T1',E12.4)
      END
 SUBROUTINE GREAD                                                  GREAD000
 INTEGER RDRUM,SDRUM,TDRUM                                         GREAD001
 DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     GREAD002
1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    GREAD003
2.  ,WO,WSC,XKT,XYY,YY,GTO                                         GREAD004
 COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        GREAD005
1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      GREAD006
2   ,TT3(30),W3(30),SST                                            GREAD007
 COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,GREAD008
1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEGREAD009
2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             GREAD010
 COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               GREAD011
1   ,XLAM,RSUM(15),B1,B2                                           GREAD012
 COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    GREAD013
1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  GREAD014
2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   GREAD015
3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  GREAD016
4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        GREAD017
5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              GREAD018
6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         GREAD019
7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                            GREAD020
7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)GREAD021
 COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      GREAD022
1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    GREAD023
2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) GREAD024
 COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      GREAD025
 COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   GREAD026
1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     GREAD027
2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  GREAD028
3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    GREAD029
4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           GREAD030
5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  GREAD031
 COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     GREAD032
1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     GREAD033
 COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    GREAD034
2    ,  T13,T14,T15,T16,XD1,YD1                                    GREAD035
3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        GREAD036
 COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II GREAD037
 COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     GREAD038
1 , I1IHT,I4IHT                                                    GREAD039
 DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          GREAD040
 EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     GREAD041
1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             GREAD042
 COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      GREAD043
 COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      GREAD044
 COMMON /GRDNTS / GXY(30,12)                                       GREAD045
 DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     GREAD046
1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               GREAD047
2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               GREAD048
3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              GREAD049
4  ,CP2X(30),CP2Y(30)                                              GREAD050
 EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))              GREAD051
 EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               GREAD052
 EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))               GREAD053
 EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))               GREAD054
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      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))
      DIMENSION ZI(30),ZDIX(30),ZDIY(30),ARPRT(18)
      EQUIVALENCE (A(1),ZI(1)),(B(1),ZDIX(1)),(C(1),ZDIY(1))
      DATA ARPRT /4HU CO,4HMPON,4HENT ,4HV CO,4HMPOM,4HENT ,4HTEMP,4HERA
     1T ,4HURE ,   4HSALI,4HN./H,4HUMID,4HPOLL,4HUTAN,4HT 1 ,4HPOLL,4HUT
     2AN,4HT 2 /
      READ 100, (COM(I),I=1,18)
      PRINT 101,(COM(I),I=1,18)
      ROA = .001
      READ 110, NX,IX,NT,IMAX,JMAX,NTIME,NVAR6,ITESTP,IPOL
      DO 2I=1,5
    2 NVCHS(I) = 0
      IF(NTIME.GE.0)READ110,(NVCHS(I),I=1,5)
      IGRID = JMAX * IMAX
      PRINT 111, NX,IX,NT,IGRID
C     IGRID IS THE NUMBER OF STATIONS IN THIS MODEL GRID NETWORK
      READ 119,DT,XD,DECLX,DCHG,XIIN,XJIN
      DECL = DECLX* .017453293
      DCHG = DCHG * .017453293
      READ 119,PHIBOT,HWEST,EM,ZW,RTIME
      H = HWEST * .017453293
    3 PRINT 112, XIIN,XJIN,PHIBOT,DT,XD
      DT = DT*60.
      PRINT 1212, RTIME
      IF(RTIME.LE.0.) RTIME = DT/60.
  700 IMARA = RTIME/DT*60.  +.5
      XD = XD * 1.E5
      NP1=NX+1
      IS = 0
      IP1 = IX+1
C     INITIAL STATION DATA INPUT   Z,  T,  U,  V,  W
      READ 119,(Z(I),I=1,NP1)
      DO 6 J=1,6
      READ 119, (YY(I,J),I=1,NP1)
    6 CONTINUE
      DO 230 I=5,6
      DO 230 N=1,NP1
  230 YY(N,I) = YY(N,I) / ROA / 100.
C     COMPUTE PERIPHERAL GRADIENTS
      DO 420  K=1,6
      READ 110,IZ1
      READ 120, (ZI(I),I=1,IZ1)
      READ 120, (ZDIX(I),I=1,IZ1)
      READ 120, (ZDIY(I),I=1,IZ1)
      K2 = 3*K
      K1 = K2-2
      PRINT 123, (ARPRT(I),I=K1,K2),(ZI(I),I=1,IZ1)
      PRINT 121, (ZDIX(I),I=1,IZ1)                                      GREAD110
      PRINT 122, (ZDIY(I),I=1,IZ1)                                      GREAD111
      DO 418 I=1,NP1                                                    GREAD112
      T1 = Z(I)                                                         GREAD113
      IF (I-IX) 417,416,417                                             GREAD114
  416 T1 = T1-.00001                                                    GREAD115
      GO TO 1418                                                        GREAD116
  417 IF (I-IP1) 1418,2418,1418                                         GREAD117
 2418 T1 = T1+.00001                                                    GREAD118
 1418 CALL XINEAR (T1,ZI,2,IZ1,L,ZDIX,GXY(I,K),ZDIY,GXY(I,K+6)          GREAD119
     1  ,T4,T4,T4,T4)                                                   GREAD120
      IF(K.LE.4) GO TO 231                                              GREAD121
      GXY(I,K) = GXY(I,K) / ROA / 100.                                  GREAD122
      GXY(I,K+6) = GXY(I,K+6) / ROA / 100.                              GREAD123
  231 PGXY(I,K) = GXY(I,K)                                              GREAD124
      CGXY(I,K) = GXY(I,K)                                              GREAD125
      PGXY(I,K+6) = GXY(I,K+6)                                          GREAD126
      CGXY(I,K+6) = GXY(I,K+6)                                          GREAD127
  418 CONTINUE                                                          GREAD128
  420 CONTINUE                                                          GREAD129
      READ 119,SOAB,SOSC,XNO,COCOB                                      GREAD130
      PRINT 119,SOAB,SOSC,XNO,COCOB                                     GREAD131
      IY = IP1                                                          GREAD132
      NP2=NX+2                                                          GREAD133
      NM1=NX-1                                                          GREAD134
      NM2=NX-2                                                          GREAD135
      IP2=IX+2                                                          GREAD136
      IP3=IX+3                                                          GREAD137
      IM1=IX-1                                                          GREAD138
      IM2=IX-2                                                          GREAD139
      IM3 = IX-3                                                        GREAD140
      I4=1                                                              GREAD141
      IA=NM1-IP1                                                        GREAD142
      EX2=-1./2.                                                        GREAD143
      EX3 = 1./3.                                                       GREAD144
      EX6 = -1./6.                                                      GREAD145
      XNV = .5                                                          GREAD146
      XNT = 1.5                                                         GREAD147
      BETV = 10.                                                        GREAD148
      BETT = 10./3.                                                     GREAD149
      DT2 = 2.*DT                                                       GREAD150
      G = 980.                                                          GREAD151
      CP = .239                                                         GREAD152
      PI = 3.1415927                                                    GREAD153
      GAM = .98E-4                                                      GREAD154
      GAM2 = 2.*GAM                                                     GREAD155
      ALF = -3.                                                         GREAD156
      XK1 = .4                                                          GREAD157
      XK2=.14                                                           GREAD158
      RALF = -1./ALF                                                    GREAD159
      RC = RALF/7.                                                      GREAD160
      T2 = (1. + ALF*RC)**2                                             GREAD161
      T3 = RC**EX3                                                      GREAD162
      CC = 3.*T3*T2                                                     GREAD163
      T4 = 3./CC                                                        GREAD164
      C32 = T4**(-.5)
      T4 = T4**1.5
      XK12 = XK1**2
      SH = XK12*T4
      HKK = SH*XK2**2/XK12
      HK2 = SH/XK12
      HKK=HKK*10.
      CPP=-CP*1.0E06
      SIG=1.354E-12
      AW=1000.*G
      AR=2.87E+06
      NTOP=NLAP+NP1
      ATC = .001
      SK = 0.86933E-06
      PI2 = PI * 2.
      DELH = (DT/86400.) * PI2
    1 PDECL  = DECL / .017453293
      PDCHG = DCHG  / .017453293
      PRINH = H     / .017453293
      PRINT 126,PDECL,PDCHG,EM,PRINH
      DO 117 I=1,NX
      T1 = (Z(I) + Z(I+1))/2.
      ZA(I) = ABS(T1)
      DZ(I) = Z(I+1) - Z(I)
  117 CONTINUE
      DO 23K=1,IM1
      I=IM1-K+1
   23 DS(K)   = ZA(I)-ZA(I+1)
      DS(IX)  = ABS(Z(1)) - ZA(1)
      DO 715 I=IP1,NP1
      TE=Z(I)-ZW
      IF (TE)715,10,715
   10 IZW=I
      GO TO 132
  715 CONTINUE
      PRINT 1000,  (Z(I),I=1,NP1),ZW
      CALL EXIT
  132 IZW1=IZW-1
      T20=ALOG(Z(IZW)/Z(IZW1))
      A1 = ALOG(1950.   /Z(IZW1))/T20
      A2 = ALOG(Z(IZW)/1950.   )/T20
   99 RETURN
  100 FORMAT(18A4)
  101 FORMAT(1X18A4///)
  110 FORMAT(14I5)
  111 FORMAT (4H NX=,I3/4H IX=,I3/4H NT=,I3/7H GRID =,I3)
  112 FORMAT (11H  XIIN    = F10.4/11H   XJIN   = F10.4/11H PHI      = F8.2
     1/11H DELTA T = F6.1/10H DISTANCE=,F7.2)
  119 FORMAT(6F12.4)
  120 FORMAT (6E12.5)
  121 FORMAT ('0X-GRAD    ',6E12.5)
  122 FORMAT ('0Y-GRAD    ',6E12.5)
  123 FORMAT ('0',3A4,' GRADIENTS--INPUT VALUES'/' HEIGHTS(M)',11F10.2)
  126 FORMAT(13H DECLINATION ,E12.4/8H CHANGE ,E12.4/ 36H INFRARED EMISS
     1IVITY OF THE SURFACE ,E12.4/12H HOUR ANGLE ,E12.4)
 1000 FORMAT(1H1,'   ZW VALUE IS INCORRECT--- HEIGHT ARRAY FOLLOWS'//
     1  (6F12.4))
 1212 FORMAT ('0TIME STEP FOR RADIATION IS',F10.2,' MINUTES')
      END
      SUBROUTINE ADVECT                                                 ADVCT000
      INTEGER RDRUM,SDRUM,TDRUM                                         ADVCT001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     ADVCT002
     1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3   ADVCT003
     2    ,WO,WSC,XKT,XYY,YY,GTO                                        ADVCT004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        ADVCT005
     1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)     ADVCT006
     2    ,TT3(30),W3(30),SST                                           ADVCT007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,ADVCT008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEADVCT009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             ADVCT010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               ADVCT011
     1    ,XLAM,RSUM(15),B1,B2                                          ADVCT012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    ADVCT013
     1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30) ADVCT014
     2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2  ADVCT015
     3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10) ADVCT016
     4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)       ADVCT017
     5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF             ADVCT018
     6    ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV        ADVCT019
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                            ADVCT020
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)ADVCT021
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      ADVCT022
     1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)   ADVCT023
     2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) ADVCT024
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      ADVCT025
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   ADVCT026
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     ADVCT027
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  ADVCT028
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    ADVCT029
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           ADVCT030
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  ADVCT031
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     ADVCT032
     1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    ADVCT033
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    ADVCT034
     2    ,  T13,T14,T15,T16,XD1,YD1                                    ADVCT035
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        ADVCT036
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II ADVCT037
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     ADVCT038
     1 , I1IHT,I4IHT                                                    ADVCT039
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          ADVCT040
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     ADVCT041
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             ADVCT042
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      ADVCT043
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      ADVCT044
      COMMON /GRDNTS / GXY(30,12)                                       ADVCT045
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     ADVCT046
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               ADVCT047
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               ADVCT048
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              ADVCT049
     4  ,CP2X(30),CP2Y(30)                                              ADVCT050
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))              ADVCT051
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               ADVCT052
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))               ADVCT053
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))               ADVCT054
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))              ADVCT055
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))             ADVCT056
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))             ADVCT057
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))             ADVCT058
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))             ADVCT059
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))             ADVCT060
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))             ADVCT061
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))             ADVCT062
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))             ADVCT063
      DIMENSION YIN2(1),YIN3(1),YIN4(1),YIN5 1)                         ADVCT064
      EQUIVALENCE (XYY(1,1,2),YIN2(1)),(XYY(1,1,3),YIN3(1))             ADVCT065
     1     ,(XYY(1,1,4),YIN4(1)),(XYY(1,1,5),YIN5(1))                   ADVCT066
      DIMENSION VAR3(50)                                                ADVCT067
      DIMENSION ALL(12,5) ,IALL(12,5)                                   ADVCT068
      EQUIVALENCE (VAR3(1),C(1)) ,(IALL(1,1),ALL(1,1))                  ADVCT069
      DOUBLE PRECISION XTIME,XT1                                        ADVCT070
      NVAR1 = 1                                                         ADVCT071
      NVAR6 = 6                                                         ADVCT072
      DO 585 I = 1,NP1                                                  ADVCT073
      U3(I) = 0.                                                        ADVCT074
      V3(I) = 0.                                                        ADVCT075
      TT3(I) = 0.                                                       ADVCT076
      W3(I) = 0.                                                        ADVCT077
      PP13(I) = 0.                                                      ADVCT078
      PP23(I) = 0.                                                      ADVCT079
  585 CONTINUE                                                          ADVCT080
C***********************************************************************ADVCT081
C**** FLOATING GRID STATIONS ARE ASSIGNED THE FOLLOWING NUMBERS ********ADVCT082
C                                                                       ADVCT083
C                                  6  4  7                              ADVCT084
C                                                                       ADVCT085
C                                  1  2  3                              ADVCT086
C                                                                       ADVCT087
C                                  8  5  9                              ADVCT088
C                                                                       ADVCT089
C**** WHERE THE COMPUTED GRADIENTS ARE APPLIED AT STATION 2 ************ADVCT090
C***********************************************************************ADVCT091
      DO 666 I=1,5                                                      ADVCT092
      IF(I.EQ.2.OR.I.EQ.3) GO TO 666                                    ADVCT093
      DO 666 J=1,12                                                     ADVCT094
      ALL(J,I) = 0.                                                     ADVCT095
  666 CONTINUE                                                          ADVCT096
C  SET DATA FROM RESTART                                                ADVCT097
C   COMPUTES THE CENTERED AND UPWIND GRADIENTS                          ADVCT098
      IU3 = 3                                                           ADVCT099
      IF (MS-2) 511,501,501                                             ADVCT100
C  SETS STATION 2   MS=1                                                ADVCT101
  511 READ (RDRUM'IS)      (YIN2(I),I=1,NWSYY)                          ADVCT102
      DO 600 I=1,12                                                     ADVCT103
      ALL(I,2) = YIN3(I)                                                ADVCT104
  600 CONTINUE                                                          ADVCT105
      SLOPX = ALL(1,2)                                                  ADVCT106
      SLOPY = ALL(2,2)                                                  ADVCT107
      HEIGHT = ALL(3,2)                                                 ADVCT108
      ETA1   = ALL(4,2)                                                 ADVCT109
      ETA2    = ALL(5,2)                                                ADVCT110
      XETA2   = ALL(6,2)                                                ADVCT111
      YETA2   = ALL(7,2)                                                ADVCT112
      IHT     =IALL(8,2)                                                ADVCT113
      IANV    =IALL(9,2)                                                ADVCT114
      ETAINX = ALL(11,2)                                                ADVCT115
      ETAINY = ALL(12,2)                                                ADVCT116
      IGOG = IGOGO                                                      ADVCT117
      LOCKYY(2) = -1                                                    ADVCT118
      IU3 = 2                                                           ADVCT119
      ALL(11,1) = ALL(11,2)                                             ADVCT120
      ALL(12,1) = ALL(12,2)                                             ADVCT121
C  SETS STATION 3   MS GT 1                                             ADVCT122
  501 DO 503 J=NVAR1,NVAR6                                              ADVCT123
      DO 503 K=1,NP1                                                    ADVCT124
      IF (MS.EQ.1) GO TO 1603                                           ADVCT125
      XYY(K,J,1) = XYY(K,J,2)                                           ADVCT126
      XYY(K,J,2) = XYY(K,J,3)                                           ADVCT127
 1603 YY(K,J)    = XYY(K,J,IU3)                                         ADVCT128
  503 CONTINUE                                                          ADVCT129
      PP23(NP1) = PP22(NP1)                                             ADVCT130
      PP13(NP1) = PP12(NP1)                                             ADVCT131
      IF(MS.EQ.1) GO TO 610                                             ADVCT132
      DO 604 I=1,12                                                     ADVCT133
      IF(I.EQ.8.OR.I.EQ.10) GO TO 1610                                  ADVCT134
      ALL(I,1) = ALL(I,2)                                               ADVCT135
      ALL(I,2) = ALL(I,3)                                               ADVCT136
      GO TO 604                                                         ADVCT137
 1610 IALL(I,1) = IALL(I,2)                                             ADVCT138
      IALL(I,2) = IALL(I,3)                                             ADVCT139
  604 CONTINUE                                                          ADVCT140
      SLOPX = ALL(1,2)                                                  ADVCT141
      SLOPY = ALL(2,2)                                                  ADVCT142
      HEIGHT = ALL(3,2)                                                 ADVCT143
      ETA1    = ALL(4,2)                                                ADVCT144
      ETA2    = ALL(5,2)                                                ADVCT145
      XETA2   = ALL(6,2)                                                ADVCT146
      YETA2   = ALL(7,2)                                                ADVCT147
      IHT     =IALL(8,2)                                                ADVCT148
      IANV    =IALL(9,2)                                                ADVCT149
      ETAINX = ALL(11,2)                                                ADVCT150
      ETAINY = ALL(12,2)                                                ADVCT151
      IGOG = IGOGO                                                      ADVCT152
  610 LOCKYY(1) = LOCKYY(2)                                             ADVCT153
      LOCKYY(2) = IS                                                    ADVCT154
  515 IF (MS-IMAX) 560,561,561                                          ADVCT155
  560 LOCKYY(3) = IS+1                                                  ADVCT156
      READ (RDRUM'IS+1)   (YIN3(I),I=1,NWSYY)                           ADVCT157
      DO 601 I=1,12                                                     ADVCT158
      ALL(I,3) = YIN4(I)                                                ADVCT159
  601 CONTINUE                                                          ADVCT160
      GO TO 562                                                         ADVCT161
  561 LOCKYY(3) = -1                                                    ADVCT162
C   STATIONS 1-3 SET   NOW SET 4-9                                      ADVCT163
  562 IF (NS-1) 563,563,564                                             ADVCT164
  563 LOCXYY(4) = -1
      ALL(11,4) = ALL(11,2)
      ALL(12,4) = ALL(12,2)
      GO TO 565
  564 LOCXYY(4) = IS-IMAX
      READ (RDRUM'LOCXYY(4)) (YIN4(I),I=1,NWSYY)
      DO 602 I=1,12
      ALL(I,4) = YIN5(I)
  602 CONTINUE
  565 IF (NS-JMAX) 566,567,567
  566 LOCXYY(5) = IS+IMAX
      READ (RDRUM'LOCXYY(5)) (YIN5(I),I=1,NWSYY)
      DO 603 L=1,12
      K = NWSYY - 12 + L
      ALL(L,5) = YIN5(K)
  603 CONTINUE
      GO TO 568
  567 LOCXYY(5) = -1
      ALL(11,5) = ALL(11,2)
      ALL(12,5) = ALL(12,2)
C  ENTIRE XYY NOW SET FOR UPWIND
  568 CONTINUE
  619 SQ2 = SQRT(2.)
C   UPWIND/CENTERED DIFFERENCE ROUTINE FOR UP TO 6 VARIABLES
      XMD = 1. /XD
      DO 649 I=1,12
      DO 649 J=1,30
      PGXY(J,I) = 0.
      CGXY(J,I) = 0.
  649 CONTINUE
      GO TO (620,642,642,620),IGOGO
  642 IF(I1IHT.LT.2) GO TO 41
      II = 6
      IJ = 1
      IK = 3
      IL = 11
      DO 644 KK = 1,2
      IF(LOCXYY(IJ).LT.0.OR.LOCXYY(IK).LT.0) GO TO 645
      ALL(II,2) = (ALL(5,IK) - ALL(5,IJ))*XMD/2.
      GO TO 615
  645 IF(LOCXYY(IJ).LT.0.AND.LOCXYY(IK).LT.0) GO TO 646
      IF(LOCXYY(IJ).LT.0) GO TO 647
      IF(LOCXYY(IK).LT.0) GO TO 648
  646 ALL(II,2) =(ALL(IL,IK) - ALL(IL,IJ))*XMD/2.
      GO TO 615
  647 ALL(II,2) = (ALL(5,IK) - ALL(IL,IJ))*XMD/2.
      GO TO 615
  648 ALL(II,2) = (ALL(IL,IK) - ALL(5,IJ))*XMD/2.
  615 II = 7
      IJ = 5
      IK = 4
      IL = 12
  644 CONTINUE
      XETA2 = ALL(6,2)
      YETA2 = ALL(7,2)
      IF(I1IHT.EQ.2) RETURN                                             ADVCT220
   41 IF(IGONY.EQ.-1) GO TO 620                                         ADVCT221
      IF(ITM.GT.1) GO TO 620                                            ADVCT222
      IF(I1IHT.EQ.1) GO TO 620                                          ADVCT223
  641 I2IHT = IHT                                                       ADVCT224
      I3IHT = IHT                                                       ADVCT225
      DO 607 J=1,3                                                      ADVCT226
      IIHT = IALL(8,J)                                                  ADVCT227
      IF(IIHT.GT.I2IHT) I2IHT= IALL(8,J)                                ADVCT228
  607 CONTINUE                                                          ADVCT229
      DO 608 J=4,5                                                      ADVCT230
      IIHT = IALL(8,J)                                                  ADVCT231
      IF(IIHT.GT.I3IHT) I3IHT = IALL(8,J)                               ADVCT232
  608 CONTINUE                                                          ADVCT233
  620 DC 599 IJXY=1,2                                                   ADVCT234
      IXY =(IJXY-1)*6                                                   ADVCT235
      IF (IJXY-1) 1501,1501,1502                                        ADVCT236
 1501 IF (LOCXYY(3)) 521,521,522                                        ADVCT237
  521 IU3 = 2                                                           ADVCT238
      GO TO 523                                                         ADVCT239
  522 IU3 = 3                                                           ADVCT240
  523 IF (LOCXYY(1)) 524,524,525                                        ADVCT241
  524 IU1 = 2                                                           ADVCT242
      GO TO 1505                                                        ADVCT243
  525 IU1 = 1                                                           ADVCT244
      GO TO 1505                                                        ADVCT245
 1502 IF (LOCXYY(4)) 1521,1521,1522                                     ADVCT246
 1521 IU3 = 2                                                           ADVCT247
      GO TO 2521                                                        ADVCT248
 1522 IU3 = 4                                                           ADVCT249
 2521 IF (LOCXYY(5)) 1524,1524,1525                                     ADVCT250
 1524 IU1 = 2                                                           ADVCT251
      GO TO 1505                                                        ADVCT252
 1525 IU1 = 5                                                           ADVCT253
C  UPWIND DIFFERENCE IN X(IJXY=1)/Y(IJXY=2) DIRECTION                   ADVCT254
 1505 IKI = 1                                                           ADVCT255
      IF(IGONY.EQ.1) IKI=IP2                                            ADVCT256
      DO 550  LR=IKI,NP1                                                ADVCT257
      IF(XYY(LR,IJXY,2)) 531,532,536                                    ADVCT258
C ABOVE CHECKS U/V  NOW INFLOW CONDITION CHECK                          ADVCT259
  531 IF (IU3-2) 435,532,435                                            ADVCT260
  435 IU3U = IU3                                                        ADVCT261
      IU2 = 2                                                           ADVCT262
      GO TO 534                                                         ADVCT263
C  UPWIND IS INFLOW--SET TO INPUT                                       ADVCT264
  532 DO 533 J=NVAR1,NVAR6                                              ADVCT265
      K = IXY+J                                                         ADVCT266
  533 PGXY(LR,K) = GXY(LR,K)                                            ADVCT267
      GO TO 540                                                         ADVCT268
  536 IF (IU1-2) 537,532,538                                            ADVCT269
  537 IU3U = 2                                                          ADVCT270
      IU2 = 1                                                           ADVCT271
      GO TO 534                                                         ADVCT272
  538 IU3U = 2                                                          ADVCT273
      IU2  = 5                                                          ADVCT274
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C  UPWIND DIFFERENCE
  534 DO 535 J=NVAR1,NVAR6
      K = IXY+J
      PGXY(LR,K) = XMD*(XYY(LR,J,IU3U)-XYY(LR,J,IU2))
  535 CONTINUE
C     C COMPUTE CENTERED DIFFERENCE
  540 DO 547 J=NVAR1,NVAR6
      K = IXY+J
      CGXY(LR,K) =((XYY(LR,J,IU3) - XYY(LR,J,2))
     1  +(XYY(LR,J,2)- XYY(LR,J,IU1)))*XMD/2.
       IF(IGONY.LT.0) GO TO 547
       IF (IU3.EQ.2.OR .IU1.EQ.2) CGXY(LR,K) =PGXY(LR,K)
  547 CONTINUE
  550 CONTINUE
  599 CONTINUE
      RETURN
      END
      SUBROUTINE RAD
C     SUBROUTINE TO COMPUTE TEMPERATURE CHANGES DUE TO RADIATION
      INTEGER RDRUM,SDRUM,TDRUM
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
     2   ,WO,WSC,XKT,XYY,YY,GTO
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
     2   ,TT3(30),W3(30),SST
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
     2    ,  T13,T14,T15,T16,XD1,YD1
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
     1 , I1IHT,I4IHT
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
      DIMENSION DTR(50)
      EQUIVALENCE (DTR(1),C(1))
  213 FORMAT ('0INITIAL PRES AND QS'/(1X2F15.5))
  106 NCL = NCLI
      IF(ITM.LT.ISTEP(1)) NCL=0
      CX = 1.
      RAINX = 0.
      IF(NCL)1108,1108,116
  116 CALL LINEAR (ITM,ISTEP,1,NTFOR, L,RAINI,RAINX,T4,T4,T4,T4,T4,T4)
      NCL = NXN(L)
      DO 934 I=1,NCL
      CALL LINEAR(ITM,ISTEP,1,NTFOR,L,ECLI(1,I),EC(I),T4,T4,T4,T4,T4,T4)
      TCL(I) = TCLI(L,I)
  934 LLC(I) = LLCI(L,I)
      CX = 1. -EC(NCL)
 1108 LLC(NCL+1) = 61
      DO 107I=IM1,NP1
      TA(I)=TT2(I)
      QA(I)=W2(I)
      COB(I) = PP12(I)*COCOB
  107 CONTINUE
C  FOLLOWING RECOMUTES EMISSIUIY H20,CO2 ATEACH STATION WHEN XD.GT.50KM
 1407 ICOM = -1
      IF (XD.GT. 50.E5) GO TO 112
      IF(IS.NE.1) GO TO 1507
  112 INEWC = INEWC+1
      IF (INEWC-INEW) 1507,1505,1505
 1505 INEWC = 0
      ICOM = 1
 1507 CONTINUE
 1408 C1 = 3.7943/PA(IP1)
C  COMPUTE PATH LENGTHS,ST4,QS
      TTW = TW
      DO 104 L=IP1,NP1
      K=L-IX
      IF (ICOM) 501,501,702
  702 DUW(K)=(PA(L)-PA(L+1))*(QA(L)+QA(L+1))/G/2.
      TTW = TTW+DUW(K)
C   CARBON DIOXIDE ASSUMED AT 320 PPM
      COA(K) = .4148239*(PA(L)-PA(L+1))
  501 IF (IPOL) 499,499,709
  499 CGA(K) = 0.
      PAAB(K) = 0.
      PASA(K) = 0.
      GO TO 502
  709 T8  = (COB(L)+COB(L+1))/2.*DZ(L)*1.E-5
      CGA(K) = T8*1.66*XNO
      PAAB(K) = T8*SOAB
      PASA(K) = T8*SOSC
  502 ST4(L) = SIG*TA(L)**4
      DST4(L) = SIG*((TA(L)+TA(L+1))/2.)**4
      CXPA = 3.7943/PA(L)
      TEX = 3.0 + 7.5 *(TA(L)-273.16)/(TA(L)-35.66)
      QS(L) = CXPA * 10.0**TEX
  104 CONTINUE
      KA = NP1-IX   +1
      IF (ICOM.EQ.1) CALL INFRAI(DUW,COA,KA,NATAL)
      IF (ITM-1) 212,212,297
  212 PRINT 213, (PA(I),QS(I),        I=IY,NP1)
C  *** SOLAR RADIATION COMPUTATIONS
  297 T3 = COS(H)
      T4 = COS(DECL)
      T6 = SIN(DECL)
      T5 = SPH*T6+CPH*T3*T4
      COSZ = T5
      H = H + DELH
      IF(H.LE.PI) GO TO 2
      H = H-PI2
      DECL= DECL+ DCHG
      PDECL = DECL/.017453293
      PRINT 299,ITM,PDECL
  299 FORMAT(//' MIDNIGHT OCCURS AT TIME STEP',I5,' NEW DECLINATION IS'
     1,E12.4)
    2 IF(T5)5,5,19
    5 CRS = 0.
      TE = 0.
      RH = 0.
      TOUPRA = 0.
      DO 6I=1,NP1
    6 DTDT(I) = 0.
      GO TO 99
   19 N1 = NP1 - IX
      CALL SOLAR2 (N1 ,PA(IY),DUW,PASA,PAAB,EC,TCL,LLC,COSZ,DTDT(IY),
     1 CRS,TE,TOUPRA,NATAL)
      GO TO (86,86,86,1414), IGOGO
   86 SINZ = SQRT(1.-COSZ*COSZ)
      SRS = -.0139 + .0467 * (SINZ/COSZ)
      SRS = AMIN1(1.,SRS)
      SRS = AMAX1(.03,SRS)
 1414 CONTINUE
      RAI(IX) = CRS * (1.-SRS)
      TOUPRA = TOUPRA + CRS*SRS
      RH = RAI(IX)
      IF(IGONY.GT.0) GO TO 99
 6843 SECZ = 1./COSZ
      IF(SECZ.GT.10.) SECZ = 10.
      IF(RAI(IX).LE.1.0E-30) RAI(IX) = 0.0
      DO 25 M=2,IX
      I = IX-M+2
      T2 = ZA(I-1)/100.
      CALL KAPPA(T2,AK)
      IF(RAI(I).LT.1.0E-20) RAI(I)=0.0
      T100 = -AK*ZA(I-1)*SECZ/100.
      IF(T100.LE.-40.0) T100 = -40.0
      RAI(I-1) = RAI(IX)*EXP(T100)
   25 DTR(I) = RAI(I) - RAI(I-1)
      DTR(1) = RAI(1)
      DO 27I=1,IM1
      M=IX-I+1
   27 DTDT(I) = DTR(I) / DS(M)
      RH = RAI(IX) - RAI(IM1)
C   INFRARED SURFACE FLUX
   99 CALL INFRA (1,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)
      RAA = RA(1) + RADMX
      RSUM(6) = DT*RA(1) + RSUM(6)
C   *** HEAT BALANCE
      LOOP = 0
      TG1= TA(IP1)
      IF(TG1- 273.16)855,855,860
  855 XLT = 677.
      GO TO 861
  860 XLT = 597.3 - 0.57*(TG1-273.16)
  861 T5 = 1. / (EM * SIG)
      IF(RAINX.GT.0) GO TO 862
      TRW = TA(IP1)
      GO TO 865
  862 TWBAR = 0.
      NC = 0
C     RAINFALL THROUGH LAYER COMPUTATION
      DO 864I=IP2,NP1
      ZWS = Z(I)
      IF(ZW.GT.ZWS.AND.ZWS.GT.0.) GO TO 863
      SN = NC
      TRW = TWBAR/SN
      GO TO 865
  863 NC = NC+1
      TWBAR = TWBAR + (TA(I)-XLT*1.E-03/CP * (QS(I)-QA(I)))
  864 CONTINUE
  865 ET1 = -.001 * ROA * XKT(IP1)
      N = 1
      AT1 = -ROA * CP * XKT(IP1)
      ST1 = ROW * CW * XKT(IM1)
  532 CONTINUE
      ET = ET1 * ((W2(IP2) - W2(IP1)) / Z(IP2))
      AT = AT1 * ((TA(IP2) - TA(IP1)) / DZ(IP1)  + GAM )
      ST = ST1 * ((TA(IP1) - TA(IM1)) / DZ(IM1))
C     RAIN EFFECT TERM  -PT-
      PT = .935*RAINX*(TRW-TA(IP1))
      T4 = T5 *(RH + RAA - AT - ST -XLT*ET + PT)
      IF(T4)74,74,870
   74 IF(LOOP)75,75,203
   75 PRINT 150,ITM,ET,AT,ST,XLT, RAA ,RH,SRS
      TG3 = TG1/2.
      GO TO 871
  870 TG3 = T4**.25
  871 GO TO (199,200,200),N
  199 N = 2
      DET1 = TG3-TG1
      TG = TG3
      IF(ABS(DET1)-ATC)882,882,181
  200 DET2 = TG3-TG2
      IF(ABS(DET2)-ATC)105,105,186
  105 TG = (TG2+TG3)/2.
      GO TO 882
  186 IF(ABS(DET1)-ATC)882,882,1106
 1106 IF(DET1)191,882,192
  191 IF(DET2)193,193,184
  192 IF(DET2)184,193,193
  184 N=3
      GO TO 203
  193 TG1 = TG2
      GO TO (199,202,203),N
  202 TG = TG3
      DET1 = DET2
      GO TO 181
  203 DET1 = DET1/2.
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      TG = TG1 + DET1
  181 LOOP = LOOP + 1
      TG2 = TG
      IF(LOOP-25)884,884,97
  884 TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)
      QSG = C1*10.0**TEX
      W2(IP1) = QSG*XMQ+(1.-XMQ)*W2(IP2)
      TA(IP1) = TG
      GO TO 532
  882 CONTINUE
      IF (W2(IP1).GT.QSG) W2(IP1) = QSG
      GO TO 404
   97 PRINT 151,ITM,ET,AT,ST,XLT, RAA ,RH,SRS ,TG
  150 FORMAT(15H  IN TIME STEP ,I3,' T**4 INITIALLY COMPUTED LESS THAN Z
     XERO'//'VALUES OF ET,AT,ST,XLT, RAA ,RH AND SRS FOLLOW'/7E12.4)
  151 FORMAT(15H  IN TIME STEP ,I3,' AFTER 25 ITERATIONS T(Z=0) DID NOT
     XCONVERGE TO WITHIN THE SPECIFIED TOLERANCE'//'VALUES OF ET,AT,ST,X
     XLT, RAA ,RH, SRS,TG FOLLOW',/8E12.4)
  404 IX1 = IX+2
  405 II = NP1-IX
C  *** INFRARED ATMOSPHERIC COOLING
      CALL INFRA(NX,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)
 1607 DO 1621 I=IX1,NP1
      L = I-IX
 1621 DT1(I) = DTDT(I)+DTT(L)
      DO 4999K=1,IM1
 4999 DT1(K) = DTDT(K)
      TSC(IX) =    TG    - TTO(IP1)
      TSC(IP1) = TSC(IX)
      TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)
      QSG = C1*10.0**TEX
      W2(IP1) = QSG
      W2(IP1)=W2(IP1)*XMQ+(1.-XMQ)*W2(IP2)
      WSC(IP1) = W2(IP1)-WO(IP1)
C  RADIATION AND HEAT BALANCE SUMS
      RSUM(1) = RSUM(1) + DT * ET * XLT
      RSUM(2) = RSUM(2) + DT * AT
      RSUM(3) = RSUM(3) + DT * ST
      RSUM(4) = RSUM(4) + DT * PT
      RSUM(5) = RSUM(5) + DT * RH
      RSUM(7) = RSUM(7) + DT * RADMX
      RSUM(8) = RSUM(8) + DT * TG**4 * SIG * EM
      RSUM(9) = RSUM(9)+DT*(TE-TOUPRA)
      K = NP1-IX+1
      RSUM(10)= RSUM(10)+DT*(RA(K)-RB(K))
      XT2 = TSC(IX)
      RANS = RA(K) * 1.E3
      RABNS= RB(K) * 1.E3
      RABS = RB(1) * 1.E3
      CRNS = TE * 1.E3
      TRAUS= (RB(K)-RA(K) + CRS*SRS) * 1.E3
      DO 5000  I=1,NP1
      TT2(I)=TSC(I)
 5000 W2(I)=WSC(I)
      HAI = AT
      HSI= ST
      CE = ET - RAINX
      RETURN
      END
 SUBROUTINE SDATA                                                  SDATA000
 INTEGER RDRUM,SDRUM,TDRUM                                         SDATA001
 DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PPI2     SDATA002
1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,WI,W2,W3    SDATA003
2   ,WO,WSC,XKT,XYY,YY,GTO                                         SDATA004
 COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        SDATA005
1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      SDATA006
2   ,TT3(30),W3(30),SST                                            SDATA007
 COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,SDATA008
1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CESDATA009
2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             SDATA010
 COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               SDATA011
1   ,XLAM,RSUM(15),B1,B2                                           SDATA012
 COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    SDATA013
1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  SDATA014
2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   SDATA015
3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  SDATA016
4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        SDATA017
5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              SDATA018
6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         SDATA019
7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                            SDATA020
7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)SDATA021
 COMMON U3(30),V3(30),TBO(30),WBO(30),CK0(30),CSW(30),PSS(30)      SDATA022
1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    SDATA023
2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) SDATA024
 COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      SDATA025
 COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   SDATA026
1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     SDATA027
2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  SDATA028
3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    SDATA029
4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           SDATA030
5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  SDATA031
 COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     SDATA032
1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     SDATA033
 COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    SDATA034
2     ,   T13,T14,T15,T16,XD1,YD1                                  SDATA035
3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        SDATA036
 COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II SDATA037
 COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     SDATA038
1 , I1IHT,I4IHT                                                    SDATA039
 DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          SDATA040
 EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     SDATA041
1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             SDATA042
 COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      SDATA043
 COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      SDATA044
 COMMON /GRDNTS / GXY(30,12)                                       SDATA045
 DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     SDATA046
1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               SDATA047
2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               SDATA048
3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              SDATA049
4  ,CP2X(30),CP2Y(30)                                              SDATA050
 EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))              SDATA051
 EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               SDATA052
 EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))               SDATA053
 EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))               SDATA054
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      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))              SDATA055
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))             SDATA056
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))             SDATA057
      EQUIVALENCE (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))              SDATA058
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))             SDATA059
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))             SDATA060
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))             SDATA061
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))             SDATA062
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))             SDATA063
      DIMENSION YIN2(1),YIN3(1),YIN4(1),YIN5(1)                         SDATA064
      EQUIVALENCE (XYY(1,1,2),YIN2(1)),(XYY(1,1,3),YIN3(1))             SDATA065
     1      ,(XYY(1,1,4),YIN4(1)),(XYY(1,1,5),YIN5(1))                  SDATA066
      DIMENSION VAR3(50)                                                SDATA067
      DIMENSION ALL(12,5) ,IALL(12,5)                                   SDATA068
      EQUIVALENCE (VAR3(1),C(1)) ,(IALL(1,1),ALL(1,1))                  SDATA069
      DOUBLE PRECISION XTIME,XT1                                        SDATA070
C   SUBROUTINE TO SET DATA AT EACH STATION INITIALLY AND AT EACH RESTART SDATA071
      IF (ITM) 11,11,301                                                SDATA072
   11 IF (IS-1) 12,12,1313                                              SDATA073
C   READ IN INITIAL TIME ONLY        FOLLOWING FOR ALL STATIONS         SDATA074
   12 CONTINUE                                                          SDATA075
      READ 2,NLAP,NPU                                                   SDATA076
      NTOP = NLAP+NP1                                                   SDATA077
      NATAL = NTOP-IX                                                   SDATA078
      DO 13I=NP2,NTOP                                                   SDATA079
      READ 1, PA(I),TA(I),QA(I),COB(I)                                  SDATA080
      PRINT 1,PA(I),TA(I),QA(I),COB(I)                                  SDATA081
   13 CONTINUE                                                          SDATA082
      ST4(NP2)=SIG*TA(NP2)**4                                           SDATA083
      NTOP1=NTOP-1                                                      SDATA084
      TW = 0.                                                           SDATA085
      IF (XIIN.EQ.1..AND.XJIN.EQ.1.) GO TO 19                           SDATA086
C     XYY(LEVEV,        VARIABLE IN YY   ,STATION)                      SDATA087
      XD1 = XD*(XIIN-1.)                                                SDATA088
      YD1 =-XD*(XJIN-1.)                                                SDATA089
      DO 191J=1,6                                                       SDATA090
  184 I = J                                                             SDATA091
  190 DO 18 K=1,NP1                                                     SDATA092
   18 XYY(K,J,2) = YY(K,J  ) -ZE2(K,I)*YD1-ZE1(K,I)*XD1                 SDATA093
      IF (J-4) 192,191,191                                              SDATA094
  192 XYY(IP1,J,2) = XYY(IX,J,2)                                        SDATA095
  191 CONTINUE                                                          SDATA096
      GO TO 25                                                          SDATA097
   19 DO 20 J=1,6                                                       SDATA098
      DO 20 I=1,NP1                                                     SDATA099
   20 XYY(I,J  ,2)  =    YY(I,J)                                        SDATA100
C   ALL CARDS READ IN AFTER ALL STATINS STARTED                         SDATA101
C   FOLLOWING AT EACH STATION AT TIMESTEP ZERO                          SDATA102
   25 IF (NTIME.LT.0) GO TO 1313                                        SDATA103
  301 IF (ITM.NE.NTIME.OR.IS.GT.1) G TO 389                             SDATA104
      IGET = ITM                                                        SDATA105
      READ 2, NTIME,K                                                   SDATA106
      DO 302 I=1,NP1                                                    SDATA107
  302 READ 1,(VARIN(I,J),J=1,4)                                         SDATA108
      DO 303 I=1,K                                                      SDATA109
      IF (NVCHS(1).EQ.1) READ 1,BR(I),(R(I,J,1),J=1,4)
      IF (NVCHS(2).EQ.1) READ 1,V3(I),(E(I,J,1),J=1,4)
  303 CONTINUE
      DO 304 I=1,NP1
      T1 = Z(I)
      IF (I.EQ.IX) T1=T1-.00001
      IF (I.EQ.IP1)T1=T1+.00001
      IF (NVCHS(1).NE.1) GO TO 305
      CALL XINEAR (T1,BR,4,K,L,R(1,1,1),GNV(I,1),
     1  R(1,2,1),GNV(I,2),R(1,3,1),GNV(I,3),R(1,4,1),GNV(I,4))
      GXY(I,1) = GNV(I,1)
      GXY(I,7) = GNV(I,2)
      GXY(I,2) = GNV(I,3)
      GXY(I,8) = GNV(I,4)
  305 IF (NVCHS(2).NE.1) GO TO 304
      CALL XINEAR (T1,V3,4,K,L,E(1,1,1),GNV(I,5),
     1  E(1,2,1),GNV(I,6),E(1,3,1),GNV(I,7),E(1,4,1),GNV(I,8))
      GXY(I,3 ) = GNV(I,5)
      GXY(I,9 ) = GNV(I,6)
      GXY(I,4 ) = GNV(I,7)
      GXY(I,10) = GNV(I,8)
  304 CONTINUE
  389 IF (ITM) 1313,1313,500
 1313 CONTINUE
      IRAT = IMARA
      INEW = 10 *IMARA
      INEWC = INEW
C  READ FOR EACH STATION   CLOUDS FROM RAD
C                          THERMAL CONDUCTIVI  IF LAND
C              ANY OTHER VARIABLE REQUIRE FOR A PARTICULAR RUN
C  READ STATION VALUES              FOLLOWING AT STATION START
      READ 2, NTFOR,NCL,NTCUV,IPOI,IGONY,ISSI1,ISSI2
      READ 67,PSFA,XLAM,DEL
      READ 68,                     SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV
   68 FORMAT(5E12.5,I12)
   67 FORMAT(8F10.2)
    1 FORMAT(7F10.2)
      PRINT 1111,PSFA,XLAM,DEL,SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV
      IGOGO = IGONY + 3
      IGOG  = IGOGO
      HEIGHT = HEIGHT*100.
      IF(HEIGHT.EQ.0.0) GO TO 313
      DO 34 I=1,IX
      K = IX-I+1
      IF(HEIGHT.LT.Z(K)) GO TO 34
      IHT = K +1
      GO TO 36
   34 CONTINUE
      IHT = 1
      GO TO 36
  313 IHT = IP1
   36 CONTINUE
      DO 30 I=1,NTCUV
      READ  5, ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2
   30 PRINT 5,ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2
```

```
      IF (NTFOR.LE.0) NTFOR = 1                                          SDATA165
      ISTEP(1) = 601                                                     SDATA166
      IF(NCL)114,114,115                                                 SDATA167
C     NUMBER OF CLOUD LAYERS,AMOUNTS AND RAINFALL RATE INPUT             SDATA168
  115 DO 933 I=1,NTFOR                                                   SDATA169
      READ  3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),   SDATA170
     1 L=1,NCL)                                                          SDATA171
      PRINT 3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),   SDATA172
     1 L=1,NCL)                                                          SDATA173
      DO 933 LL=1,NCL                                                    SDATA174
  933 LLCI(I,LL) = LLCI(I,LL)     -IX                                    SDATA175
  114 NCLI = NCL                                                         SDATA176
      LLCI(1,NCL+1) = 61                                                 SDATA177
      GO TO (1520,1520,1520,1510),IGOGO                                  SDATA178
 1510 READ 1  , SRS,ROW,CW,XMQ,RADMX                                     SDATA179
      PRINT 1  ,SRS,ROW,CW,XMQ,RADMX                                     SDATA180
      READ  1  , (XKT(I),I=1,IMI)                                        SDATA181
      PRINT 1  , (XKT(I),I=1,IMI)                                        SDATA182
 1520 CONTINUE                                                           SDATA183
      DO 699I=1,20                                                       SDATA184
      SOU1(I) = 0.                                                       SDATA185
      SOU2(I) = 0.                                                       SDATA186
      IF(I.GT.6) GO TO 699                                               SDATA187
      SH1(I) = 0.                                                        SDATA188
      SH2(I) = 0.                                                        SDATA189
  699 CONTINUE                                                           SDATA190
      IF(IPOI)700,700,701                                                SDATA191
  701 READ 2, (ITS1(I),I=1,ISSI1)                                        SDATA192
      PRINT 2,(ITS1(I),I=1,ISSI1)                                        SDATA193
      READ 1  , (SOU1(I),I=1,ISSI1)                                      SDATA194
      PRINT 1  ,(SOU1(I),I=1,ISSI1)                                      SDATA195
      READ 1  ,(SH1(I),I=1,6)                                            SDATA196
      PRINT 1  ,(SH1(I),I=1,6)                                           SDATA197
      IF(IPOI.EQ.1) GO TO 700                                            SDATA198
      READ 2,  (ITS2(I),I=1,ISSI2)                                       SDATA199
      PRINT 2, (ITS2(I),I=1,ISSI2)                                       SDATA200
      READ 1  ,  (SOU2(I),I=1,ISSI2)                                     SDATA201
      PRINT 1  , (SOU2(I),I=1,ISSI2)                                     SDATA202
      READ 1  ,(SH2(I),I=1,6)                                            SDATA203
      PRINT 1  ,(SH2(I),I=1,6)                                           SDATA204
  700 DO 117  L=NP2,NTOP1                                                SDATA205
      IF(QA(L+1).LE.0.0) QA(L+1) = 0.001                                 SDATA206
      T1 = (QA(L)+QA(L+1))/2.*(PA(L)-PA(L+1))/G                          SDATA207
      TW = TW + T1                                                       SDATA208
      K=L-IX                                                             SDATA209
      DUW(K) = T1                                                        SDATA210
      COA(K) = .4148239*(PA(L)-PA(L+1))                                  SDATA211
C     T8 = (COB(K)+COB(K+1))/2.*DZ(L)*1.E-5                              SDATA212
C  DZ(L) NOT SET ABOVE THE TOP PREDICTION LEVEL                          SDATA213
      T8 = (COB(L)+COB(L+1))/2.*1.E-5  *AR/G*TA(L)/PA(L)*                SDATA214
     1    (PA(L)-PA(L+1))                                                SDATA215
C   XNO IS THE INFRARED ABSORPTION COEFFICIENT FOR AEROSOLS              SDATA216
      CGA(K) = T8*1.66*XNO                                               SDATA217
      PAAB(K) = T8*SOAB                                                  SDATA218
      PASA(K) = T8*SOSC                                                  SDATA219
      ST4(L+1)=SIG*(TA(L+1)**4)                                         SDATA220
      DST4(L) = (ST4(L)+ST4(L+1))*.5                                    SDATA221
  117 CONTINUE                                                          SDATA222
      DO 23 N=1,JMAX                                                    SDATA223
      DO 23 M=1,IMAX                                                    SDATA224
      XD1 = XD*(M-1)                                                    SDATA225
      YD1 =-XD*(N-1)                                                    SDATA226
      DO 23 I=1,NP1                                                     SDATA227
      T1 = XD1*ZE1(I,1)+YD1*ZE2(I,1)+XYY(I,1,2)                         SDATA228
      T2 = XD1*ZE1(I,2)+YD1*ZE2(I,2)+XYY(I,2,2)                         SDATA229
      T3 =  T1**2+T2**2                                                 SDATA230
      IF (T3) 23,23,223                                                 SDATA231
  223 T3 = SQRT(T3)                                                     SDATA232
      IF (T3.GT.SAVE)  SAVE = T3                                        SDATA233
   23 CONTINUE                                                          SDATA234
      TDEL = XD/SAVE                                                    SDATA235
      SAVE = 0.01                                                       SDATA236
      DO 108  I=IY,NX                                                   SDATA237
      T1  =-2.*G*(Z(I+1)-Z(I))                                          SDATA238
      T2  =AR*(TT2(I)+TT2(I+1))                                         SDATA239
  108 VAR3(I) = EXP(T1/T2)                                              SDATA240
      IF (NPU) 101,101,102                                              SDATA241
  101 PA(IP1)= PSFA                                                     SDATA242
  109 DO 111  I=IY,NX                                                   SDATA243
      PA(I+1)=PA(I)*VAR3(I)                                             SDATA244
  111 CONTINUE                                                          SDATA245
      GO TO 103                                                         SDATA246
  102 PA(NP1) = PSFA                                                    SDATA247
  110 DO 113 I=IY,NX                                                    SDATA248
      K = NX - I + IY                                                   SDATA249
      PA(K)=VAR3(K)/PA(K+1)                                             SDATA250
  113 CONTINUE                                                          SDATA251
  103 CONTINUE                                                          SDATA252
      IF (IGONY) 51,51,150                                              SDATA253
  150 DEL = 0.                                                          SDATA254
      GO TO 52                                                          SDATA255
   51 ROW = 1.                                                          SDATA256
      CW  = .935                                                        SDATA257
      XMQ =1.                                                           SDATA258
      IF (XLAM) 52,4,52                                                 SDATA259
    4 DEL=.055                                                          SDATA260
   52 CONTINUE                                                          SDATA261
   33 XM = MS-1                                                         SDATA262
      YM = NS-1                                                         SDATA263
      XD1 = XD*XM                                                       SDATA264
      YD1 =-XD*YM                                                       SDATA265
      DO 29 J=1,6                                                       SDATA266
  284 I = J                                                             SDATA267
  290 DO 28 K=1,NP1                                                     SDATA268
   28 YY(K,J  ) = XYY(K,J,2) +ZE2(K,I)*YD1+ZE1(K,I)*XD1                 SDATA269
      IF (J-4) 291,29,29                                                SDATA270
  291 YY(IP1,J) = YY(IX,J)                                              SDATA271
   29 CONTINUE                                                          SDATA272
C     ALL INITIAL DATA SET                                              SDATA273
      GO TO (797,796,796,795),IGOGO                                     SDATA274
  795 DO 14 J=1,4                                                       SDATA275
      DO 14I=1,IX                                                       SDATA276
   14 YY(I,J) = 0.                                                      SDATA277
      GO TO 1114                                                        SDATA278
  797 DO 798 J=1,2                                                      SDATA279
      DO 798 I=1,IX                                                     SDATA280
  798 YY(I,J) = 0.                                                      SDATA281
      GO TO 1114                                                        SDATA282
  796 IQI = 5                                                           SDATA283
      IF(W2(IX).EQ.0.0) IQI =4                                          SDATA284
      DO 141J=IQI,6                                                     SDATA285
      DO 141I=1,IX                                                      SDATA286
  141 YY(I,J) = 0.                                                      SDATA287
      IF(IHT.EQ.1) GO TO 122                                            SDATA288
      IIHT = IHT - 1                                                    SDATA289
      DO 121 I=1,IIHT                                                   SDATA290
      U2(I) = 0.0                                                       SDATA291
  121 V2(I) =0.0                                                        SDATA292
  122 IF(IGONY.EQ.0) GO TO 1114                                         SDATA293
      IF(IANV.GT.1) GO TO 118                                           SDATA294
      DO 119 I=1,IX                                                     SDATA295
  119 V2(I) = 0.0                                                       SDATA296
      GO TO 1114                                                        SDATA297
  118 DO 120 I=1,IX                                                     SDATA298
  120 U2(I) = 0.0                                                       SDATA299
 1114 READ 16, (YY(I,3),I=1,IP1)                                        SDATA300
   16 FORMAT(6E12.4)                                                    SDATA301
      IF(IGONY.EQ.0) GO TO 10                                           SDATA302
      U2(IP1) = 0.                                                      SDATA303
      V2(IP1) = 0.                                                      SDATA304
   10 DO 9I=1,NP1                                                       SDATA305
      TTO(I)=TT2(I)                                                     SDATA306
      TT2(I)=0.                                                         SDATA307
      TT1(I) = TT2(I)                                                   SDATA308
      U1(I) = U2(I)                                                     SDATA309
      V1(I) = V2(I)                                                     SDATA310
      WO(I)=W2(I)                                                       SDATA311
      W2(I)=0.                                                          SDATA312
      W1(I) = W2(I)                                                     SDATA313
      TT3(I) = TT2(I)                                                   SDATA314
      U3(I) = U2(I)                                                     SDATA315
      V3(I) = V2(I)                                                     SDATA316
      W3(I) = W2(I)                                                     SDATA317
      PP21(I) = PP22(I)                                                 SDATA318
      PP11(I) = PP12(I)                                                 SDATA319
      PP13(I) = PP12(I)                                                 SDATA320
      PP23(I) = PP22(I)                                                 SDATA321
    9 CONTINUE                                                          SDATA322
      ICK = ITESTP                                                      SDATA323
      ISTR=0                                                            SDATA324
      LY=1                                                              SDATA325
      C5 = 1.                                                           SDATA326
      C6 = 1.                                                           SDATA327
      GD2 = 0.                                                          SDATA328
      PHI = PHIBOT + XDT1*(JMAX-NS)                                     SDATA329
      T1= PHI * .017453293
      H= HWEST + (MS-1) * XDT1/COS(T1)
      PHIR = T1
      CPH = COS(PHIR)
      SPH = SIN(PHIR)
      SF = 14.584E-5*SIN(T1)
      DTSF = DT*SF
      C1 = 3.7943/PA(IP1)
      GSF = G/SF
      GFR =GSF/ROW
      DTA = DT
      DTA2 = 2.*DT
      T10 = XLAM*DEL/2.
      DO 720 I=1,NX
      ZDL2(I) = (ZA(I) + T10) **2
  720 CONTINUE
      TK = XK2**2
      DO 725 I=1,IM1
      CKO(I) = TK*ZDL2(I)
  725 CONTINUE
      TK = XK12
      DO 735 I=IP1,NX
      CKO(I) = TK*ZDL2(I)
  735 CONTINUE
      DO 2000I=1,15
 2000 RSUM(I) = 0.
      RANS = 0.
      RABNS = 0.
      RABS = 0.
      CRNS = 0.
      CRS = 0.
      RAA = 0.
      TOUPRA = 0.
      IF(XLAM) 45,99,45
   45 IF(DEL)60,50,60
   50 T6 = Z(IP2)/XLAM
      T6 = ABS(T6)
      B1 = 1./XK1*ALOG(T6)
      T7 = Z(IM1)/XLAM
      T7 = ABS(T7)
   54 B2 = 1./XK1*ALOG(T7)
      GO TO 70
   60 T8 = XLAM/2./PI
      T16=T8**EX2
      T9=SQRT(G)*DEL*T16
      DO 65 I=1,NX
      T10 = -ZA(I)/T8
      CSW(I) = T9*EXP(T10)
   65 CONTINUE
      XKU(IP1) = CKO(IP1)*CSW(IP1)
      XKT(IP1) = XKU(IP1)
      XKU(IM1) = CKO(IM1)*CSW(IM1)
      XKT(IM1) = XKU(IM1)
   70 CONTINUE
      GO TO 99
  500 CONTINUE
   99 RETURN
    2 FORMAT ( 14I5)
    3 FORMAT(I4,I2,F6.2,5(I3,F5.1,F4.0))
    5 FORMAT(I5,4F10.2,2A4)
 1111 FORMAT(' SFC P =',F10.4/' LAMBDA =',F10.4/' DELTA =',F10.4/' SLOPX
     1=',F10.4/' SLOPY =',F10.4/' HEIGHT(+)/DEPTH(-) =',F10.4/' THE INPU
     2T SURFACE HEIGHT FOR OPEN WATER BOUNDARIES'/' INPUT X-ETA =',F10.4
     3/' INPUT Y-ETA =',F10.4/' IANV =',I10//)
      END
      SUBROUTINE TTSQ                                                   TTSQ 000
C     COMPUTE FCN  A  AND SET INDICES                                   TTSQ 001
      INTEGER RDRUM,SDRUM,TDRUM                                         TTSQ 002
      DOUBLE PRECISION Z1,Z2                                            TTSQ 003
      DOUBLE PRECISION AZER(36)                                         TTSQ 004
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     TTSQ 005
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    TTSQ 006
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         TTSQ 007
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        TTSQ 008
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      TTSQ 009
     2   ,TT3(30),W3(30),SST                                            TTSQ 010
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,TTSQ 011
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CETTSQ 012
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             TTSQ 013
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               TTSQ 014
     1   ,XLAM,RSUM(15),B1,B2                                           TTSQ 015
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    TTSQ 016
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  TTSQ 017
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   TTSQ 018
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  TTSQ 019
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        TTSQ 020
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              TTSQ 021
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         TTSQ 022
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                            TTSQ 023
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)TTSQ 024
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      TTSQ 025
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    TTSQ 026
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) TTSQ 027
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      TTSQ 028
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   TTSQ 029
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     TTSQ 030
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  TTSQ 031
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    TTSQ 032
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           TTSQ 033
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  TTSQ 034
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     TTSQ 035
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     TTSQ 036
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    TTSQ 037
     2   ,   T13,T14,T15,T16,XD1,YD1                                    TTSQ 038
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        TTSQ 039
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II TTSQ 040
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     TTSQ 041
     1 ,I1IHT,I4IHT                                                     TTSQ 042
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          TTSQ 043
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     TTSQ 044
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))            .TTSQ 045
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      TTSQ 046
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      TTSQ 047
      COMMON /GRDNTS / GXY(30,12)                                       TTSQ 048
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     TTSQ 049
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               TTSQ 050
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               TTSQ 051
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              TTSQ 052
     4  ,CP2X(30),CP2Y(30)                                              TTSQ 053
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))              TTSQ 054
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))
C *******           ***** TTSQ   ******          *******
      IF (ITM.GT.1)GO TO 18
      DO117 I=1,36
  117 AZER(I) =0.
   18 IF(NVCHS(2).EQ.1)GO TO 41
C     T--OCEAN
      DO110  J=2,IM1
      Z1=U2(J)*PTX(J)+V2(J)*PTY(J)
      FA(J)=-Z1+DT1(J)
  110 CONTINUE
      I1=1
      II=2
      IT=IM2
      I2=IM3
      I3=IM1
      I4=1
      IF(IGONY.EQ.1) GO TO 146
      I5 = IT-  IHT+1
      IF(IHT.GT.2) GO TO 131
  146 I5 = IM3
      I1 = 1
      II = 2
  131 CALL CTW(TT1,TT2,TT3,TTO)
      IF(IGONY.EQ.1) GO TO 145
C     W=S  OCEAN
      DO130 J=2,IM1
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)
      FA(J)=-Z1
  130 CONTINUE
      CALL CTW(W1,W2,W3,WO)
C     W=Q  ATMOSPHERE
  145 DO140 J=IP2,NX
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)
      FA(J)=-Z1
  140 CONTINUE
   41 I1 = IP1
      II=IP2
      IT=NM1
      I2=NM2
      I3=NX
      I5=IA
      IF(NVCHS(2).EQ.1)GO TO 22
      CALL CTW(W1,W2,W3,WO)
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C     T--ATMOSPHERE
      DO120 J=IP2,NX
      Z1=U2(J)*PTX(J)+V2(J)*PTY(J)
      Z2=GAM2/(DZ(J)+DZ(J-1))*(XKT(J)-XKT(J-1))
      Z3=U2(J)*SLOPX+V2(J)*SLOPY
      FA(J)=-Z1+Z2+DT1(J) - VVEL(J) * GAM-Z3*GAM
  120 CONTINUE
      CALL CTW(TT1,TT2,TT3,TTO)
   22 IF(IPOL-1)169,164,161
  161 DO162 J=IP2,NX
      Z1 = U2(J)*XP2(J)+V2(J)*PP2Y(J)
      Z2 = 0.
      IF ((J-IX).GT.6) GO TO 162
      Z2 = SH2(20)*SH2(J-IX) /(Z(J+1)-Z(J-1))*2./ROA
  162 FA(J) = -Z1+Z2
      CALL CTW (PP21,PP22,PP23,AZER)
  164 DO165 J=IP2,NX
      Z1 = U2(J)*XP1(J)+V2(J)*PP1Y(J)
      Z2 = 0.
      IF ((J-IX).GT.6) GO TO 165
      Z2 = SH1(20)*SH1(J-IX) /(Z(J+1)-Z(J-1))*2./ROA
  165 FA(J) = -Z1+Z2
      CALL CTW (PP11,PP12,PP13,AZER)
  169 CONTINUE
      RETURN
C *******                ***** GWC    ******               *******
      ENTRY GWC
C     COMPUTE GEOSTROPHIC WINDS AND CURRENTS
      DIMENSION SX(30),SY(30)
      EQUIVALENCE (A(1),SX(1)),(B(1),SY(1))
C     STORE SCALED T AND W TEMPORARILY
      DO310 I=IP3,NP1
      T1 = DZ(I-1)/TT2(I)**2
      SX(I) = T1*GXY(I,3)
      SY(I) = T1*GXY(I,9)
  310 CONTINUE
      CALL LINEAR (ITM,ICUV,4,NTCUV,J,XOCU,CU(IX),XOCV,CV(IX),XACU,
     1   CU(NP1),XACV,CV(NP1))
      CUT = CU(NP1)/TTO(NP1)
      CVT = CV(NP1)/TTO(NP1)
      DO330 J=IP2,NX
      SUMX = 0.
      SUMY = 0.
  315 J1=J+1
      DO320 I=J1,NP1
      SUMX = SUMX + SX(I)
      SUMY = SUMY + SY(I)
  320 CONTINUE
      T1 = GSF*TT2(J)
      TX = T1*SUMX
      TY = T1*SUMY
      CU(J) = CUT*TT2(J) + TY
      CV(J) = CVT*TT2(J) - TX
  330 CONTINUE
      GO TO (399,  1,1,399), IGOGO
```

```
    1 IF(IHT.GT.1) GO TO 850
      XETA2 = CV(IX)/GSF
      YETA2 =-CU(IX)/GSF
      GO TO 851
  850 CV(IX) = GSF * XETA2
      CU(IX) = -GSF * YETA2
  851 DO340 I=2,IX
      T3 =(CTY(I) + CTY(I-1))/2.
      T4 =(CWY(I) + CWY(I-1))/2.
      T1 = PST(I-1)*T3 + PSS(I-1)*T4
      T5 = (CTX(I) + CTX(I-1))/2.
      T6 = (CWX(I) + CWX(I-1))/2.
      T2 = PST(I-1)*T5 + PSS(I-1)*T6
      SX(I) = .001*T2*DZ(I-1)
      SY(I) = .001*T1*DZ(I-1)
  340 CONTINUE
      DO350 K=2,IX
      I=IX-K+1
      SUMX = 0.
      SUMY = 0.
      DO345 J=I,IM1
      SUMX = SUMX + SX(J+1)
      SUMY = SUMY + SY(J+1)
  345 CONTINUE
      CU(I) = CU(IX) + GFR*SUMY
      CV(I) = CV(IX) - GFR*SUMX
  350 CONTINUE
  399 RETURN
C *******              ***** CUV    ******             *******
      ENTRY CUV
C     COMPUTE U AND V COEFFICIENTS FOR GAUSSIAN ELIMINATION SCHEME
      A(I1) = 0.
      Z1 = DT2/(DZ(I1) + DZ(II))
      Z2 = XKU(I1)/DZ(I1)
      Z3 = XKU(II)/DZ(II)
      BR(I1) = C5 + Z1*(Z3 + Z2)
      BG      = -DTSF
      C(I1) = -Z1*Z3
      IF(I1-1) 111,111,12
  111 IF(IHT.EQ.1) GO TO 11
   35 IIHT = IHT -1
      DO 36 I=I,IIHT
      U3(I) = 0.
   36 V3(I) = 0.
      GO TO 13
   11 U3(I1) = U2(I1) + DTSF * (V2(I1)-CV(I1))
      V3(I1) = V2(I1) + DTSF * (CU(I1)-U2(I1))
      GO TO 13
   12 U3(IT+2) = CU(IT+2)
      V3(IT+2) = CV(IT+2)
   13 Z4 = C6 * U2(II) - DTSF * CV(II) - GD2 * U1(II)
     1 - DT * (U2(II) * PUX(II) + V2(II) * PUY(II))
      Z5 = Z1*Z2*U2(I1)
      Z6 = C6*V2(II) + DTSF*CU(II) - GD2*V1(II)
     1 - DT * (U2(II) * PVX(II) + V2(II) * PVY(II))
```

```
      Z7 = Z1*Z2*V2(I1)                                                 TTSQ 220
      F(I1,1) = Z4 + Z5                                                 TTSQ 221
      F(I1,2) = Z6 + Z7                                                 TTSQ 222
      DO 30 I=II,IT                                                     TTSQ 223
      Z1 = DT2/(DZ(I) + DZ(I+1))                                        TTSQ 224
      Z2 = XKU(I)/DZ(I) + 0.5*VVEL(I+1)                                 TTSQ 225
      Z3 = XKU(I+1)/DZ(I+1) - 0.5*VVEL(I+1)                             TTSQ 226
      A(I) = -Z1*Z2                                                     TTSQ 227
      BR(I) = C5 + Z1*(Z3 + Z2)                                         TTSQ 228
      C(I) = -Z1*Z3                                                     TTSQ 229
      F(I,1) = C6*U2(I+1) - DTSF*CV(I+1) - GD2*U1(I+1)                  TTSQ 230
     1 - DT * (U2(I+1)* PUX(I+1)+ V2(I+1)* PUY(I+1))                    TTSQ 231
      F(I,2) = C6*V2(I+1) + DTSF*CU(I+1) - GD2*V1(I+1)                  TTSQ 232
     1 - DT * (U2(I+1)* PVX(I+1)+ V2(I+1)* PVY(I+1))                    TTSQ 233
   30 CONTINUE                                                          TTSQ 234
      C(IT) = 0.                                                        TTSQ 235
      F(IT,1) = F(IT,1) + Z1*Z3*U2(IT+2)                                TTSQ 236
      F(IT,2) = F(IT,2) + Z1*Z3*V2(IT+2)                                TTSQ 237
      Z1 = 1./(BR(I1)**2 + BG**2)                                       TTSQ 238
      E(I1,1,1) = Z1*BR(I1)                                             TTSQ 239
      E(I1,1,2) = -Z1*BG                                                TTSQ 240
      E(I1,2,1) = -E(I1,1,2)                                            TTSQ 241
      E(I1,2,2) = E(I1,1,1)                                             TTSQ 242
      FST(I1,1) = E(I1,1,1)*F(I1,1) + E(I1,1,2)*F(I1,2)                 TTSQ 243
      FST(I1,2) = E(I1,2,1)*F(I1,1) + E(I1,2,2)*F(I1,2)                 TTSQ 244
      E(I1,1,1) = -C(I1)*E(I1,1,1)                                      TTSQ 245
      E(I1,1,2) = -C(I1)*E(I1,1,2)                                      TTSQ 246
      E(I1,2,1) = -E(I1,1,2)                                            TTSQ 247
      E(I1,2,2) = E(I1,1,1)                                             TTSQ 248
      DO 5 I=II,I2                                                      TTSQ 249
      Z1 = A(I)*E(I-1,1,1) + BR(I)                                      TTSQ 250
      Z2 = A(I)*E(I-1,1,2) + BG                                         TTSQ 251
      Z3 = Z1**2 + Z2**2                                                TTSQ 252
      R(I,1,1) = Z1/Z3                                                  TTSQ 253
      R(I,1,2) = -Z2/Z3                                                 TTSQ 254
      R(I,2,1) = -R(I,1,2)                                              TTSQ 255
      R(I,2,2) = R(I,1,1)                                               TTSQ 256
      E(I,1,1) = -R(I,1,1)*C(I)                                         TTSQ 257
      E(I,1,2) = -R(I,1,2)*C(I)                                         TTSQ 258
      E(I,2,1) = -E(I,1,2)                                              TTSQ 259
      E(I,2,2) = E(I,1,1)                                               TTSQ 260
    5 CONTINUE                                                          TTSQ 261
      Z1 = A(IT)*E(I2,1,1) + BR(IT)                                     TTSQ 262
      Z2 = A(IT)*E(I2,1,2) + BG                                         TTSQ 263
      Z3 = Z1**2 + Z2**2                                                TTSQ 264
      R(IT,1,1) = Z1/Z3                                                 TTSQ 265
      R(IT,1,2) = -Z2/Z3                                                TTSQ 266
      R(IT,2,1) = -R(IT,1,2)                                            TTSQ 267
      R(IT,2,2) = R(IT,1,1)                                             TTSQ 268
      DO 10 I=II,IT                                                     TTSQ 269
      F(I,1) = F(I,1) - A(I)*FST(I-1,1)                                 TTSQ 270
      F(I,2) = F(I,2) - A(I)*FST(I-1,2)                                 TTSQ 271
      FST(I,1) = R(I,1,1)*F(I,1) + R(I,1,2)*F(I,2)                      TTSQ 272
      FST(I,2) = R(I,2,1)*F(I,1) + R(I,2,2)*F(I,2)                      TTSQ 273
   10 CONTINUE                                                          TTSQ 274
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      U3(I3) = FST(IT,1)                                                TTSQ 275
      V3(I3) = FST(IT,2)                                                TTSQ 276
      DO 20 I=I4,I5                                                     TTSQ 277
      NR=IT-I                                                           TTSQ 278
      EU3 = E(NR,1,1) *U3(NR+2)                                         TTSQ 279
       EV3 = E(NR,1,2) *V3(NR+2)                                        TTSQ 280
      U3(NR+1)=EU3+EV3+FST(NR,1)                                        TTSQ 281
      EU3 = E(NR,2,1) *U3(NR+2)                                         TTSQ 282
      EV3 = E(NR,2,2) * V3(NR+2)                                        TTSQ 283
      V3(NR+1)=EU3+EV3+FST(NR,2)                                        TTSQ 284
   20 CONTINUE                                                          TTSQ 285
   99 CONTINUE                                                          TTSQ 286
      RETURN                                                            TTSQ 287
      END                                                               TTSQ 288
      SUBROUTINE EXCK
      INTEGER RDRUM,SDRUM,TDRUM
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
     2   ,WO,WSC,XKT,XYY,YY,GTO
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
     2   ,TT3(30),W3(30),SST
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
     2   ,   T13,T14,T15,T16,XD1,YD1
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
     1 ,I1IHT,I4IHT
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
      DOUBLE PRECISION AA(9)
C     PST  AND  PSS  TABLES FOR TALOP  REPLACED BY -AA-
      DATA AA/0.79701864,0.131710842E-03,-0.611831499E-07,.588194023E-01
     X,-0.25310441E-02,0.287971530E-05,-0.811465413E-02,0.389187483E-04,
     X.47660041E-04/
 3000 DO 1  I=1,NP1
      IF (DABS(U2(I)).LT.( 1.E-35))  U2(I)=0.
      IF (DABS(V2(I)).LT.( 1.E-35))  V2(I)=0.
   86 T1=U2(I)**2 + V2(I)**2
      WS(I) = SQRT(T1)
    1 CONTINUE
      IF(XLAM)106,105,106
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```
  105 W9=WS(IZW)*A1+WS(IZW1)*A2                                         EXCK 055
  401 HBAR=1.54165E-04*(W9**2)                                          EXCK 056
      H3=1.39536*HBAR                                                   EXCK 057
  405 T23 = SQRT(G)                                                     EXCK 058
  403 DO 100  I=1,NP1                                                   EXCK 059
      T21=HBAR/(DEL*2.*PI)                                              EXCK 060
      IF(T21)1001,1001,1002                                             EXCK 061
 1001 CSW(I)=0.                                                         EXCK 062
      GO TO 100                                                         EXCK 063
 1002  T22=1./SQRT(T21)                                                 EXCK 064
      T24=-ZA(I)*2.*PI*DEL/HBAR                                         EXCK 065
      IF (T24+75.) 300,301,301                                          EXCK 066
  300 CSW(I)=0.                                                         EXCK 067
      GO TO 100                                                         EXCK 068
  301 CSW(I)=T23*T22*EXP(T24)*DEL                                       EXCK 069
  100 CONTINUE                                                          EXCK 070
      TK=XK2**2                                                         EXCK 071
  407 DO 101  I=1,IM1                                                   EXCK 072
      T25=ZA(I)+HBAR/2.                                                 EXCK 073
      CKO(I)=TK*(T25**2)                                                EXCK 074
  101 CONTINUE                                                          EXCK 075
  409 DO 102  I=IP1,NX                                                  EXCK 076
      T26 = ZA(I)+HBAR/2.                                               EXCK 077
      CKO(I)=XK12*(T26**2)                                              EXCK 078
  102 CONTINUE                                                          EXCK 079
  411 XKU(IP1)=CKO(IP1)*CSW(IP1)                                        EXCK 080
      XKT(IP1)=XKU(IP1)                                                 EXCK 081
      XKU(IM1)=CKO(IM1)*CSW(IM1)                                        EXCK 082
      XKT(IM1)=XKU(IM1)                                                 EXCK 083
  106 J2=IM2                                                            EXCK 084
      IMA =   IHT - 1                                                   EXCK 085
      IF(IMA.EQ.0) IMA=1                                                EXCK 086
      IIPP1 = IP1-IMA  + 1                                              EXCK 087
      GO TO(412,413,413,412),IGOGO                                      EXCK 088
  412 IMA = IP1                                                         EXCK 089
      IIPP1 = IP1                                                       EXCK 090
      J2 = NX                                                           EXCK 091
  413 DO 41 J=IMA,IP2,IIPP1                                             EXCK 092
      DO 40 I=J,J2                                                      EXCK 093
      T1 = (U2(I+1) - U2(I))/DZ(I)                                      EXCK 094
      IF (ABS(T1) .LT.(1.E-35))  T1 = 0.                                EXCK 095
  131 T1 = T1**2                                                        EXCK 096
  132 T2 = (V2(I+1) - V2(I))/DZ(I)                                      EXCK 097
      IF (ABS(T2) .LT.(1.E-35))  T2 = 0.                                EXCK 098
  141 T2 = T2**2                                                        EXCK 099
  142 T3 = T1 + T2                                                      EXCK 100
      XCS =  SQRT(T3)                                                   EXCK 101
      IF (I.EQ.1) CSOUT(1) = XCS                                        EXCK 102
      IF (I.EQ.NX)CSOUT(2) = XCS                                        EXCK 103
      TB =  (TT2(I+1)+TT2(I))/2.+TBO(I)                                 EXCK 104
      T6 = XCS    + CSW(I)                                              EXCK 105
      T7 = T6**2                                                        EXCK 106
      T6 = CKO(I)*T6                                                    EXCK 107
      CL =  (TT2(I+1)-TT2(I))/DZ(I)                                     EXCK 108
    3 IF(I-IX)6,40,4                                                    EXCK 109
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```
C   ATMOSPHERIC
    4 CL = CL+GAM+GTO(I)+.00061*TB*((W2(I+1)-W2(I))/DZ(I)+GWO(I))
      T7 = TB*T7
      T11= G*CL/TB
      T12 = HK2*CKO(I)
      TEST = RALF
      GO TO 8
C   OCEANIC
    6 SB = (W2(I+1)+W2(I))/2.+WBO(I)
      TTB= TB-273.16
      PST(I) = AA(4)+2.*AA(7)*TTB+AA(5)*SB   +3.*AA(9)*TTB**2 +
     X 2.*AA(8)*SB   *TTB + AA(6)*SB   **2
      PSS(I) = AA(1)+AA(5)*TTB+2.*AA(2)*SB   +AA(8)*TTB**2+2.*AA(6)*
     X SB   *TTB + 3.*AA(3)*SB   **2
      IF (SB.LE.0)  PSS(I)=0.
      T4 = PST(I)*CL+PST(I)*GTO(I)
      T5 = PSS(I)*(W2(I+1) - W2(I))/DZ(I)+PSS(I)*GWO(I)
      CL = -.001*(T4+T5)
      T11 = G*CL
      TEST = 1.E16
      T12 = HK2 * ZDL2(I)
    8 IF(T7)1003,1003,1004
 1003 IF (CL) 35,19,10
 1004 IF (CL) 1030,19,1031
   19 RI(I) = 0.
      GO TO 15
C     CHECK MAGNITUDE OF CL(I)/T7 TO RESTRICT OVERFLOW EXCEPTION
 1030 CLL1 = ABS(CL)
      CLL=ALOG10(CLL1)
      GO TO 1032
 1031 CLL  = ALOG10(CL)
 1032 T7L=ALOG10(T7)
      CHECK1 = CLL-T7L
      IF(CHECK1-13.)1024,10,10
 1024 RI(I)= G*CL/T7
      IF(RI(I)-TEST)15,15,10
   10 RI(I) = TEST
   15 IF(RI(I))25,20,20
C   RI G.T. ZERO
   20 IF(I-IX)21,21,22
C   OCEANIC
   21 EV = BETV
      ET = BETT
      XV = -XNV
      XT = -XNT
      GO TO 23
C   ATMOSPHERIC
   22 EV = ALF
      ET = ALF
      XV = 2.
      XT = 2.
   23 T8 = (1. + EV*RI(I))**XV
      T9 = (1. + ET*RI(I))**XT
      XKU(I) = T6*T8
      XKT(I) = T6*T9
      GO TO 40                                                          EXCK 165
   25 IF(RI(I) + RC)35,35,30                                            EXCK 166
C  RI G.T. -RC. AND L.T. ZERO                                           EXCK 167
   30 T10 = 1. - ALF*RI(I)                                              EXCK 168
      XKU(I) = T6/T10**2                                                EXCK 169
      XKT(I) = XKU(I)/T10                                               EXCK 170
      GO TO 40                                                          EXCK 171
C  RI L.E. -RC                                                          EXCK 172
   35 T11 = ABS(T11)                                                    EXCK 173
      XKT(I) = T12*SQRT(T11)                                            EXCK 174
      IF(T7)1006,1006,1007                                              EXCK 175
 1006 XKU(I)=0.                                                         EXCK 176
      GO TO 40                                                          EXCK 177
 1007 T13 = ABS(RI(I))                                                  EXCK 178
      T13 = T13**EX6                                                    EXCK 179
      XKU(I) = XKT(I)*C32*T13                                           EXCK 180
   40 CONTINUE                                                          EXCK 181
      J2=NX                                                             EXCK 182
   41 CONTINUE                                                          EXCK 183
C  SET LIMITS ON ATMOSPHIC . K                                          EXCK 184
      T13 = 1.E7                                                        EXCK 185
      TEST = 100.                                                       EXCK 186
  415 DO 60 I=IP1,NX                                                    EXCK 187
      IF (ZA(I).GE.(1.E4)) TEST=1.E4                                    EXCK 188
      IF (XKU(I).LT.TEST)  XKU(I) = TEST                                EXCK 189
      IF (XKT(I).LT.TEST)  XKT(I) = TEST                                EXCK 190
      IF (XKT(I).GT.T13)   XKT(I) = T13                                 EXCK 191
      IF (XKU(I).GT.T13)   XKU(I) = T13                                 EXCK 192
   60 CONTINUE                                                          EXCK 193
C     SET LIMITS ON OCEANIC K                                           EXCK 194
 1009 DO 1013  I=1,IM1                                                  EXCK 195
      IF(XKT(I)-.0014)1011,1011,1017                                    EXCK 196
 1017 IF(XKU(I)-.014) 1012,1012,1013                                    EXCK 197
 1011 XKT(I)=.0014                                                      EXCK 198
 1012 XKU(I)=.0140                                                      EXCK 199
 1013 CONTINUE                                                          EXCK 200
   99 RETURN                                                            EXCK 201
      END                                                               EXCK 202
      SUBROUTINE BIV
      INTEGER RDRUM,SDRUM,TDRUM
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3
     2   ,WO,WSC,XKT,XYY,YY,GTO
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)
     2   ,TT3(30),W3(30),SST
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20
     2    ,  T13,T14,T15,T16,XD1,YD1
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)
     1 , I1IHT,I4IHT
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))
C *******               ***** BIV    ******            *******
      T41 = TT2(IP1) - 273.16 + TTO(IP1)
      T21 = TT2(IP1) -  35.66 + TTO(IP1)
      T31 = 3.0    + 7.5   *T41/T21
      QSG = C1*10.**T31
C     COMPUTE  W  SCALE FACTORS AT INTERFACE IN INITIAL TIME STEP
      IF (ITM-1) 1,2,2
    1 IF (IGONY) 111,111,112
  111 WO(IP1) = QSG
  112 W2(IP1) =0.0
      DWO(IP1)=WO(IP2)-WO(IP1)
      GWO(IP1)=DWO(IP1)/Z(IP2)
      GO TO 11
    2 W2(IP1)=QSG*XMQ+(1.-XMQ)*(W2(IP2)+WO(IP2))-WO(IP1)
   11 IF(DEL)20,40,20
C     SEC.  3.3.1
   20 T1 = ROA*XKU(IP1) / DZ(IP1)
      T2 = ROW*XKU(IM1) / DZ(IM1)
      T3 = T1*U2(IP2) + T2*U2(IM1)
      T4 = T1*V2(IP2) + T2*V2(IM1)
      T5 = T1 + T2
      U2(IX) = T3/T5
      V2(IX) = T4/T5
      GO TO (60,61,64,60),IGOGO
   61 IF(IANV.EQ.1) GO TO 62
      U2(IX)= 0.0
      U2(IP1) = U2(IX)
      V2(IP1) = V2(IX)
      GO TO 70
   62 V2(IX) = 0.0
      V2(IP1) = V2(IX)
      U2(IP1) = U2(IX)
      GO TO 70
   60 U2(IX) =0.0
      U2(IP1) = 0.0
      V2(IX) = 0.0
      V2(IP1) = 0.0
      GO TO 70
   64 U2(IP1) = U2(IX)
      V2(IP1) = V2(IX)
   70 T10 = U2(IX)**2 + V2(IX)**2
      WS(IX) = SQRT(T10)
      WS(IP1) = WS(IX)
 1001 T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3
      IF(ITM.EQ.0) CE = 0.
      CF=W2(IM1)*CE/T8+WO(IM1)*CE/T8
      T9 = +CF/ROW/XKT(IM1)
   30 W2(IX) = T9 * DZ(IM1) + W2(IM1) - DWO(IM1)
      IF(ITM-1)32,99,99
   32 WO(IX) = T9 * DZ(IM1) + WO(IM1)
      W2(IX) = 0.0
      DWO(IM1) = WO(IX) - WO(IM1)
      GWO(IM1) = DWO(IM1) /(-Z(IM1))
   31 GO TO 99
C     SEC.  3.3.2
   40 CONTINUE
      T3 = B1 + SQRT(ROA/ROW) * B2
      T4 = WS(IP2) - WS(IM1)
      IF(XLAM) 41,41,42
   41 UST = WS(IP2)/ B1
      GO TO ( 141,141,141,142),IGOGO
  142 WS(IX) = 0.
      GO TO 43
  141 WS(IX) = WS(IM1) + SQRT(ROA/ROW) * UST * B2
      GO TO 43
   42 UST = T4/T3
      WS(IX) = WS(IP2)-UST*B1
   43 WS(IP1) = WS(IX)
      T5 = WS(IP2) - WS(IX)
      T6 = T5/T4
      U2(IX) = U2(IP2) - (U2(IP2) - U2(IM1))*T6
      V2(IX) = V2(IP2) - (V2(IP2) - V2(IM1))*T6
      IF(IGONY.EQ.0) GO TO 44
      U2(IX) = 0.
      V2(IX) = 0.
   44 U2(IP1) = U2(IX)
      V2(IP1) = V2(IX)
      QST = (W2(IP2) - W2(IP1))/B1+DWO(IP1)/B1
      T7 = ABS(UST)
      IF(ITM.EQ.0) RAINX=0.
      CE =(-ROA*T7*QST/1000.)-RAINX
      T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3
      CF = W2(IM1)*CE/T8+WO(IM1)*CE/T8
      XKU(IP1) = UST**2 * DZ(IP1) / WS(IP2)
      XKT(IP1) = XKU(IP1)
      IF(IGONY.GT.0) GO TO 99
   49 XKU(IM1) = UST**2 * DZ(IM1) / ABS(WS(IX)-WS(IM1)) * (ROA/ROW)
      XKT(IM1) = XKU(IM1)
      SST = CF/SQRT(ROW*ROA)/T7
   50 W2(IX) = W2(IM1) + SST*B2 - DWO(IM1)
   51 IF(ITM-1)52,99,99
   52 WO(IX) = CF/ROW/XKT(IM1)*DZ(IM1)+WO(IM1)
      W2(IX) = 0.0
      DWO(IM1) = WO(IX) - WO(IM1)
      GWO(IM1) = DWO(IM1) /(-Z(IM1))
   99 IF (IPOL-1) 999,992,990
  990 CALL LINEAR (ITM,ITS2,1,ISSI2,L,SOU2,T2,T4,T4,T4,T4,T4,T4)
      SH2(20) = T2
      T2 = SH2(1) * T2
      PP22(IP1) = T2*DZ(IP1)/XKT(IP1)/ROA+PP22(IP2)
  992 CALL LINEAR (ITM,ITS1,1,ISSI1,L,SOU1,T1,T4,T4,T4,T4,T4,T4)
      SH1(20) = T1
      T1 = SH1(1) * T1
      PP12(IP1) = T1*DZ(IP1)/XKT(IP1)/ROA+PP12(IP2)
  999 RETURN
C *******             ***** CTW    ******            *******
      ENTRY CTW(X1,X2,X3,XO)
C     COMPUTE COEFFICIENTS FOR T,W IN ATMOSPHERE OR OCEAN
      DOUBLE PRECISION Z1,Z2,Z3,AD,AAD,AAAD
      DOUBLE PRECISION X1,X2,X3,XO,CX
      DIMENSION X1(1),X2(1),X3(1),XO(1)
      A(I1)=0.
      Z1=DT2/(DZ(II)+DZ(I1))
      Z2=XKT(I1)/DZ(I1) + 0.5*VVEL(II)
      Z3=XKT(II)/DZ(II) - 0.5*VVEL(II)
      C(I1)=-Z1*Z3
      B(I1)=C5+Z1*(Z3+Z2)
      AD=C6*X2(II)+Z2*Z1*(X2(I1)+XO(I1))-GD2*(X1(II))
      AAD=DT*FA(II)
      AAAD=(B(I1)-C5)*XO(II)+C(I1)*XO(II+1)
      D(I1)=AD+AAD-AAAD
      DO210  J=II,IT
      Z1=DT2/(DZ(J+1)+DZ(J))                                            BIV  165
      Z2=XKT(J)/DZ(J)   + 0.5*VVEL(J+1)                                 BIV  166
      Z3=XKT(J+1)/DZ(J+1) - 0.5*VVEL(J+1)                               BIV  167
      A(J)=-Z1*Z2                                                       BIV  168
      C(J)=-Z1*Z3                                                       BIV  169
      B(J)=C5+Z1*(Z3+Z2)                                                BIV  170
      D(J)=C6*X2(J+1)-GD2*X1(J+1)+DT*FA(J+1)                            BIV  171
      D(J)=D(J)-(A(J)*XO(J)+(B(J)-C5)*XO(J+1)+C(J)*XO(J+2))             BIV  172
  210 CONTINUE                                                          BIV  173
      D(IT)=D(IT)+Z1*Z3*(X2(IT+2)+XO(IT+2))+C(IT)*XO(IT+2)              BIV  174
      C(IT)=0.                                                          BIV  175
      CST(I1)=-C(I1)/B(I1)                                              BIV  176
      DST(I1)=D(I1)/B(I1)                                               BIV  177
      DO211 J=I1,I2                                                     BIV  178
      Z1=A(J)*CST(J-1)+B(J)                                             BIV  179
      CST(J)=-C(J)/Z1                                                   BIV  180
      Z2=D(J)-A(J)*DST(J-1)                                             BIV  181
  211 DST(J) = Z2/Z1                                                    BIV  182
      Z1=D(IT)-A(IT)*DST(I2)                                            BIV  183
      Z2=A(IT)*CST(I2)+B(IT)                                            BIV  184
      X3(I3)=Z1/Z2                                                      BIV  185
      IF(IGONY.GT.0) GO TO 212                                          BIV  186
      IF (IHT.EQ.1) GO TO 212                                           BIV  187
      IIHT = IHT -1                                                     BIV  188
      DO 256 I=1,IIHT                                                   BIV  189
  256 X3(I) = 0.                                                        BIV  190
  212 DO221 J=I4,I5                                                     BIV  191
      NR=IT-J                                                           BIV  192
      CX = CST(NR) * X3(NR+2)                                           BIV  193
  221 X3(NR+1) = CX + DST(NR)                                           BIV  194
      RETURN                                                            BIV  195
      END                                                               BIV  196
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 SUBROUTINE TEMPRT                                                      TMPRT000
 INTEGER RDRUM,SDRUM,TDRUM                                              TMPRT001
 DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12          TMPRT002
1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3        TMPRT003
2    ,WO,WSC,XKT,XYY,YY,GTO                                             TMPRT004
 COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)             TMPRT005
1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)          TMPRT006
2    ,TT3(30),W3(30),SST                                                TMPRT007
 COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,TMPRT008
1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CETMPRT009
2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2                 TMPRT010
 COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                    TMPRT011
1    ,XLAM,RSUM(15),B1,B2                                               TMPRT012
 COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)         TMPRT013
1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)      TMPRT014
2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2       TMPRT015
3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)      TMPRT016
4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)            TMPRT017
5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF                  TMPRT018
6    ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV             TMPRT019
7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                                 TMPRT020
7   ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)TMPRT021
 COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)           TMPRT022
1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)        TMPRT023
2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)     TMPRT024
 COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                           TMPRT025
 COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6        TMPRT026
1   ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3         TMPRT027
2   ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME      TMPRT028
3   ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2        TMPRT029
4   ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2               TMPRT030
5   ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                      TMPRT031
 COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL          TMPRT032
1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                         TMPRT033
 COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20         TMPRT034
2     ,  T13,T14,T15,T16,XD1,YD1                                        TMPRT035
3   ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                            TMPRT036
 COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II      TMPRT037
 COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)          TMPRT038
1 , I1IHT,I4IHT                                                         TMPRT039
 DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)               TMPRT040
 EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))          TMPRT041
1   ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))                 TMPRT042
 COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                           TMPRT043
 COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                           TMPRT044
 COMMON /GRDNTS / GXY(30,12)                                           'TMPRT045
 DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)          TMPRT046
1   ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)                   TMPRT047
2   ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)                   TMPRT048
3   ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)                  TMPRT049
4   ,CP2X(30),CP2Y(30)                                                  TMPRT050
 EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))                   TMPRT051
 EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))                    TMPRT052
 EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))                    TMPRT053
 EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))                    TMPRT054
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      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))
      IF(ITM.LE.1)ICTR = 0
      ICTR = ICTR + 1
      IF(ICTR.LT.1)GO TO 888
      ICTR = 0
      PRINT 1, ITM,NS,MS
    1 FORMAT ('1TIME STEP',I5,' FOR STATION',2I5)
      GO TO (550,551,552,553),IGOGO
  550 PRINT 554
      GO TO 501
  554 FORMAT(1H+,40X,'(COASTAL CORNER STATION)')
  551 PRINT 555
      GO TO 501
  555 FORMAT(1H+,40X,'(COASTAL STATION)')
  552 PRINT 556
      GO TO 501
  556 FORMAT(1H+,40X,'(WATER STATION)')
  553 PRINT 557
  557 FORMAT(1H+,40X,'(LAND STATION)')
  501 PRINT 4
      DO 10 IP=1,NP1
      PRINT 2, Z(IP),U2(IP),V2(IP),TT2(IP),W2(IP),XKT(IP), XKU(IP),
     1  VVEL(IP),DT1(IP)
   10 CONTINUE
      PRINT 13, RANS,RABNS,RABS,RAA,CRNS,CRS,TOUPRA
   13 FORMAT(/'        RANS                RABNS                  RABS
     1    RAA                CRNS                CRS               TOUPRA'/
     2  7E18.8)
      PRINT 14, SRS,CE,CF,HAI,HSI,H3,TRAUS
   14 FORMAT(/'        SRS                CE                  CF
     1    HAI               HSI                H3               TRAUS '/
     2  7E18.8)
      PRINT 15, (RSUM(I),I=1,8)
   15 FORMAT(/'         LE              A                S               P
     1             R(1-A)           RA               MAN             T2**4
     2 '/ 8E16.6)
    4 FORMAT(//'  HEIGHT         U2            V2            TEMP
     1  W2           XKT           XKU           VVEL           DT1 '/)
    2 FORMAT(9E14.5)
  888 RETURN
      ENTRY TEMGRA
      PRINT 5
    5 FORMAT(' THE FOLLOWING ARE COMPUTED GRADIENTS FOR RESTART'/'     P
     1UX            PUY            PVX            PVY            PTX
     2    PTY            PWX            PWY         HEIGHT'/)
      DO 6I=1,NP1
      PRINT 7, PUX(I),PUY(I),PVX(I),PVY(I),PTX(I),PTY(I),PWX(I),PWY(I),
  1 Z(I)                                                                TMPRT110
  6 CONTINUE                                                            TMPRT111
    PRINT 778                                                           TMPRT112
    DO 777 I=1,NP1                                                      TMPRT113
    PRINT 7,CUX(I),CUY(I),CVX(I),CVY(I),CTX(I),CTY(I),CWX(I),CWY(I)    TMPRT114
   1,Z(I)                                                               TMPRT115
777 CONTINUE                                                            TMPRT116
778 FORMAT ('OCENTERED GRADIENTS')                                      TMPRT117
  7 FORMAT(8E14.5,F8.0)                                                 TMPRT118
    RETURN                                                              TMPRT119
    END                                                                 TMPRT120
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      SUBROUTINE INFRAI (WA,COA,KA,NTOP)                                INFRA000
C  SET TRANSMISSION VALUES FOR CO2 AND H2O                              INFRA001
      DIMENSION WA(1),COA(1),CGA(1),STB(1),ST4(1),LLC(1),EC(1),DTT(1)  INFRA002
     1 ,RA(1),RB(1),PA(1)                                               INFRA003
      DIMENSION TAUF(50,20)                                             INFRA004
      DATA AW /4.0833333/                                               INFRA005
      MM1 = NTOP-1                                                      INFRA006
      IF (KA.GT.20) GO TO 999                                           INFRA007
      KSAV = KA                                                         INFRA008
      DO 70 LR=1,KSAV                                                   INFRA009
      KUHN = 1                                                          INFRA010
      UW = 0.                                                           INFRA011
      UC = 0.                                                           INFRA012
      DO135 I=LR,MM1                                                    INFRA013
      UW = UW+WA(I)                                                     INFRA014
      UC = UC+COA(I)                                                    INFRA015
      TC = .185*EXP(-.32*UC**.4)                                        INFRA016
  136 CALL XUHN(UW,EW,KUHN)                                             INFRA017
  135 TAUF(I,LR) = .815-EW+TC                                           INFRA018
      IF (LR-1) 70,70,245                                               INFRA019
  245 KUHN = 1                                                          INFRA020
      UC = 0.                                                           INFRA021
      UW = 0.                                                           INFRA022
      I1 = LR-1                                                         INFRA023
      DO155 I=1,I1                                                      INFRA024
      K = LR-I                                                          INFRA025
      UW = WA(K)+UW                                                     INFRA026
      UC = COA(K)+UC                                                    INFRA027
      TC = .185*EXP(-.32*UC**.4)                                        INFRA028
      CALL XUHN (UW,EW,KUHN)                                            INFRA029
  155 TAUF(K,LR) = .815-EW+TC                                           INFRA030
   70 CONTINUE                                                          INFRA031
      RETURN                                                            INFRA032
      ENTRY INFRA (NIP,STB,ST4,LLC,EC,DTT,PA,RA,RB,CGA)                 INFRA033
C   COMPUTES INFRARED RADIATION IN PRESENCE OF CLOUDS AND  POLLUTANTS   INFRA034
      N1P1 = MIN0(NIP,KSAV)                                             INFRA035
      NSTART = MIN0 (2,N1P1)                                            INFRA036
      DO 40 LR=NSTART,N1P1                                              INFRA037
      LSAV = 1                                                          INFRA038
      DO 31 I=1,6                                                       INFRA039
      IF (LLC(I).GT.NTOP) GO TO 32                                      INFRA040
      IF (LR.GT.LLC(I)) LSAV = I+1                                      INFRA041
   31 CONTINUE                                                          INFRA042
   32 LL = LSAV                                                         INFRA043
      TP = 1.                                                           INFRA044
      UAA = 0.                                                          INFRA045
      E2 = 1.                                                           INFRA046
      RCL = 0.                                                          INFRA047
      ECP = 1.                                                          INFRA048
      RA(LR) = 0.                                                       INFRA049
C  RCL=R(CLD),ECP=PRODUCT(1-EC),E2=AIR TRANSMISSION                     INFRA050
      DO 35 I=LR,MM1                                                    INFRA051
      IF (LLC(LL).NE.I) GO TO  33                                       INFRA052
C  COMPUTE CLD RADIATION  MANABE AND STRICKLER 1964 JAS                 INFRA053
      RCL = RCL+EC(LL)*ST4(I)*ECP*E2                                    INFRA054
      ECP = ECP*(1.-EC(LL))
      LL = LL+1
   33 IF (CGA(I).LE.0) GO TO 34
      UAA = UAA+CGA(I)
      TP = EXP(-UAA)
   34 TT = TP*TAUF(I,LR)
      RA(LR) = RA(LR)+STB(I)*(E2-TT)*ECP
      E2 = TT
   35 CONTINUE
      RA(LR) = RA(LR)+RCL
      IF (N1P1.LE.1) GO TO 99
      IF (LR.EQ.1) GO TO 40
      I1 = LR-1
      RB(LR) = 0.
      RCL = 0.
      ECP = 1.
      E2 = 1.
      UAA = 0.
      LL = LSAV -1
      TP = 1.
      DO 60 K=1,I1
      I = LR-K
      IF (LL.LT.1) GO TO 55
C  ASSUMES CLD TOP IS AT LEVEL ABOVE CLD BASE
      IF (LLC(LL).NE.I)  GO TO 55
      RCL = RCL+EC(LL)*ST4(I+1)*ECP*E2
      ECP = ECP*(1.-EC(LL))
      LL = LL-1
   55 IF (CGA(I).LE.0) GO TO 56
      UAA = UAA+CGA(I)
      TP = EXP(-UAA)
   56 TT = TP*TAUF(I,LR)
      RB(LR) = RB(LR)+STB(I)*(E2-TT)*ECP
      E2 = TT
   60 CONTINUE
      RB(LR) = RB(LR)+RCL+ ECP*TT*ST4(1)
   40 CONTINUE
      T1 = RB(2)-RA(2)
      RB(1) = ST4(1)
      DO 80 LR=3,N1P1
      TT = RB(LR)-RA(LR)
      E2 = AW*(TT-T1)/(PA(LR)-PA(LR-1))
      T1 = TT
      IF (LR.EQ.3)  ECP = E2
      IF(LR.EQ.2) GO TO 79
      DTT(LR-1)=(PA(LR-1)-PA(LR-2))/(PA(LR)-PA(LR-2))*(E2-ECP)+ECP
   79 ECP = E2
   80 CONTINUE
      DTT(1) = 0.
   99 RETURN
  999 PRINT 1, KA
    1 FORMAT ('1 KA GT 20 -- RUN TERMINATED',I5)
      CALL EXIT
      END
      SUBROUTINE LINEAR (ITM,ISTEP,NV,NA,I,VAR1, AC1,VAR2, AC2,         LINER000
     1   VAR3, AC3,VAR4, AC4)                                           LINER001
      DIMENSION  STEP(1),VAR1(1),VAR2(1),VAR3(1),VAR4(1),ISTEP(1)       LINER002
      MM = -1                                                           LINER003
      GO TO 19                                                          LINER004
      ENTRY       XINEAR (XTM,STEP,NV,NA,I,VAR1,AC1,VAR2,AC2,VAR3,AC3,  LINER005
     1 VAR4,AC4)                                                        LINER006
      MM = 1                                                            LINER007
   19 IF (NA.LE.1) GO TO 60                                             LINER008
      DO 40 L=2,NA                                                      LINER009
      I = L-1                                                           LINER010
      IF (MM) 25,25,26                                                  LINER011
   26 IF (XTM-STEP(L))131,30,40                                         LINER012
   25 IF (ITM-ISTEP(L)) 31,30,40                                        LINER013
   30 I = L                                                             LINER014
      TIMES = 0.                                                        LINER015
      GO TO 49                                                          LINER016
   40 CONTINUE                                                          LINER017
  131 TSTART = XTM-STEP(I)                                              LINER018
      TFINAL = STEP(I+1)-STEP(I)                                        LINER019
      GO TO 127                                                         LINER020
   31 TSTART = ITM - ISTEP(I)                                           LINER021
      TFINAL = ISTEP(I+1) - ISTEP(I)                                    LINER022
  127  TIMES = TSTART/TFINAL                                            LINER023
   49 GO TO (50,51,52,53),NV                                            LINER024
   53  AC4 = VAR4(I) + (VAR4(I+1) - VAR4(I))*TIMES                      LINER025
   52  AC3 = VAR3(I) + (VAR3(I+1) - VAR3(I))*TIMES                      LINER026
   51  AC2 = VAR2(I) + (VAR2(I+1) - VAR2(I))*TIMES                      LINER027
   50  AC1 = VAR1(I) + (VAR1(I+1) - VAR1(I))*TIMES                      LINER028
      GO TO 1                                                           LINER029
   60 GO TO (61,62,63,64),NV                                            LINER030
   64 AC4 = VAR4(1)                                                     LINER031
   63 AC3 = VAR3(1)                                                     LINER032
   62 AC2 = VAR2(1)                                                     LINER033
   61 AC1 = VAR1(1)                                                     LINER034
      I = 1                                                             LINER035
    1 RETURN                                                            LINER036
      END                                                               LINER037
      SUBROUTINE SOLAR2 (NP1 ,PA,DUW,PASA,PAAB,EC,TCL,LLC,CSZI,DTDT,
     1 XIN5,TE,TOPRA,NTOP)
      DIMENSION PA(1),DUW(1),PASA(1),PAAB(1),EC(1),TCL(1),LLC(1),DTDT(1)
      ATWA(AP,AC) = SQRT((.000949*AP+.051)/AC)
      CO3 = 980./240.
      XIO = 1.95/60.
      COSZ = CSZI
C     COMPUTE TRANSMISSION THROUGH CLDS  ABOVE  BDY LAYER
      VALUE = 1.
      IF (COSZ.GT.0.17365) GO TO 13
      VALUE = COSZ/.17365
      COSZ = .17365
   13 TC = 1.
      XMP = PA(1)/1013.5/COSZ
      LSAV = 0
      DO 20 I=1,6
      IF (LLC(I).GT.NTOP) GO TO 21
      IF (LLC(I).LT.NP1) GO TO 18
      K = TCL(I)
      CALL TRANS(XMP,T2,K)
      TC = TC*(1.-EC(I)*(1.-T2))
      GO TO  20
   18 LSAV = I
   20 CONTINUE
   21 K    = NTOP-1
      UT = 0.
      UAB= 0.
      USC= 0.
      DTDT(1) = 0.
      DO 24 I=NP1,K
      UT = UT+DUW(I)
      UAB = UAB+PAAB(I)
   24 USC = USC+PASA(I)
      UT = UT-DUW(NP1)
      TPS  = 1.
      TPA  = 1.
      IF (UAB.GT.0) TPA  = EXP(-UAB)
      IF (USC.GT.0) TPS  = EXP(-USC)
      TPAM = TPA
      TPSM = TPS
      XCV = XIO*COSZ*VALUE
      TOPRA = 0.
      TCM = TC
      DO 50 K=1,NP1
      I = NP1-K+1
      T1 = 1.041-0.16*ATWA(PA(I  ),COSZ)
      TAU1 = .485+.515*T1
      UT  = UT +DUW (I)
      TAU2 = .077*(UT/COSZ)**.3
      A = TC*TPA*TPS
      GNM = XCV*TAU1
      WNM =-XCV*TAU2
      T1 = A*(GNM+WNM)
      IF (K.GT.1) GO TO 31
      TE = T1
      XIN5 = TE
      GO TO 41
   31 UAB = UAB+PAAB(I)
      USC = USC+PASA(I)
      IF (PAAB(I).GT.0) TPAM = EXP(-UAB)
      IF (PASA(I).GT.0) TPSM = EXP(-USC)
      IF (LSAV.EQ.0)  GO TO 29
      IF (LLC(LSAV).NE.I) GO TO 29
      LR = TCL(LSAV)
      CALL TRANS(XMP,T3,LR)
      TCM = TC*(1.-EC(LSAV)*(1.-T3))
      LSAV = LSAV-1
   29 T2 = T1*(1.-TC+TCM)
      T3 =  T2*(1.-TPS+TPSM)
      TOPRA = TOPRA+A*(GN-GNM)+0.9*T1*(TC-TCM)+T2*(TPS-TPSM)
      RAAB = A*(WN-WNM) + 0.1*T1*(TC-TCM)+T3*(TPA-TPAM)
      TAU1 = CO3*RAAB/(PA(I)-PA(I+1))
      IF (K.GT.2) DTDT(I+1) = TAU1+(PA(I+1)-PA(I))/(PA(I+2)-PA(I))*
     1 (DTU-TAU1)
      XIN5 = T3*(1.-TPA+TPAM)
   41 TPA = TPAM
      TPS = TPSM
      TC = TCM
      GN = GNM
      WN = WNM
      DTU = TAU1
   50 CONTINUE
      RETURN
      END
      SUBROUTINE XUHN (UW,EW,KUHN)                                      XUHN 000
      T1 = ALOG10 (UW)                                                  XUHN 001
      GO TO (31,33,35,37,39,42),KUHN                                    XUHN 002
   31 IF (T1+4.) 32,33,33                                               XUHN 003
   32 EW = .11288 * ALOG10(1+12.635*UW)                                 XUHN 004
      GO TO 49                                                          XUHN 005
   33 IF (T1+3.) 34,35,35                                               XUHN 006
   34 KUHN = 2                                                          XUHN 007
      EW = 0.104 * T1 + 0.442                                           XUHN 008
      GO TO 49                                                          XUHN 009
   35 IF (T1+1.5) 36,37,37                                              XUHN 010
   36 KUHN = 3                                                          XUHN 011
      EW = 0.121 * T1 + 0.491                                           XUHN 012
      GO TO 49                                                          XUHN 013
   37 IF (T1+1.) 38,39,39                                               XUHN 014
   38 KUHN = 4                                                          XUHN 015
      EW = 0.146 * T1+0.527                                             XUHN 016
      GO TO 49                                                          XUHN 017
   39 IF(T1) 40,41,41                                                   XUHN 018
   40 KUHN = 5                                                          XUHN 019
      EW = 0.161*T1 + 0.542                                             XUHN 020
      GO TO 49                                                          XUHN 021
   41 KUHN = 6                                                          XUHN 022
   42 EW = 0.136 * T1+0.542                                             XUHN 023
   49 RETURN                                                            XUHN 024
      END                                                               XUHN 025
      SUBROUTINE TRANS(XMP,PS1,NCT)                                     TRANS000
      A = XMP                                                           TRANS001
      NBR = NCT                                                         TRANS002
      GO TO (1,2,3,4,5,6,7,8,9),NBR                                     TRANS003
    1 PS1 = .1626 + .0054 * A                                           TRANS004
      GO TO 98                                                          TRANS005
    2 PS1 = .2684 - .0101 * A                                           TRANS006
      GO TO 98                                                          TRANS007
    3 PS1 = .3658 - .0149 * A                                           TRANS008
      GO TO 98                                                          TRANS009
    4 PS1 = .3658 - .0149 * A                                           TRANS010
      GO TO 98                                                          TRANS011
    5 PS1 = .2363 + .0145 * A                                           TRANS012
      GO TO 98                                                          TRANS013
    6 PS1 = .4130 - .0014 * A                                           TRANS014
      GO TO 98                                                          TRANS015
    7 PS1 = .5456 - .0236 * A                                           TRANS016
      GO TO 98                                                          TRANS017
    8 PS1 = .8717 - .0179 * A                                           TRANS018
      GO TO 98                                                          TRANS019
    9 PS1 = .9055 - .0638 * A                                           TRANS020
   98 PS1 = AMIN1(1.,PS1)                                               TRANS021
      PS1 = AMAX1(0.,PS1)                                               TRANS022
   99 RETURN                                                            TRANS023
      ENTRY      KAPPA(ZIN,XOUT)                                        TRANS024
      DIMENSION AK(6),Z(6)                                              TRANS025
      DATA AK /.637,.351,.235,.165,.116,.0977/                          TRANS026
      DATA Z  /2.0,5.0,10.0,20.0,50.0,100.0/                            TRANS027
      IF(ZIN.LE.2.) GO TO 50                                            TRANS028
      IF(Z(6)-ZIN)15,15,13                                              TRANS029
   15 XOUT=AK(6)                                                        TRANS030
      GO TO 99                                                          TRANS031
   13 DO 10 I=2,6                                                       TRANS032
      IF(ZIN-Z(I))14,10,10                                              TRANS033
   10 CONTINUE                                                          TRANS034
   14 L=I-1                                                             TRANS035
      IU=I                                                              TRANS036
      XOUT=AK(L)-(Z(L)-ZIN)/(Z(L)-Z(IU))*(AK(L)-AK(IU))                 TRANS037
      GO TO 99                                                          TRANS038
   50 XOUT = 1.034 - .5698*ALOG(ZIN)                                    TRANS039
      GO TO 99                                                          TRANS040
      END                                                               TRANS041
      SUBROUTINE FILES                                                  FILES000
C        THIS ROUTINE DEFINES FILES FOR VARIOUS RUNS WITHOUT            FILES001
C        RECOMPILATIONS OF MAJOR PROGRAMS                               FILES002
      COMMON /TAPBLK/ IUAR96,IUAR97,IUAR98,IUAR99                       FILES003
C   UNIT  95  STORAGE FILE FOR PRINT -- TAPE OR DISK SEQUENTIAL         FILES004
C     DEFINE FILE 95(36,2376,L,IUAR97)      NOT USED FOR SEQUENTIAL     FILES005
C   UNITS 99,96 FOR YY TO STORE FOR COMPUTATION OF GRADIENTS--DIRECT ACCFILES006
      DEFINE FILE 96(36,1488,L,IUAR96)                                  FILES007
C     DEFINE FILE 98(NO. STATIONS,4*NCR,L,IUAR98)                       FILES008
C   UNIT  98  FOR RESTART VARIABLES -- DIRECT ACCESS                    FILES009
      DEFINE FILE 97(36,3012,L,IUAR97)                                  FILES010
      DEFINE FILE 98(36,6868,L,IUAR98)                                  FILES011
C     DEFINE FILE 96/99(NO. STATIONS,4*NWSYY,L,IUAR96/IUAR99)           FILES012
      DEFINE FILE 99(36,1488,L,IUAR99)                                  FILES013
      RETURN                                                            FILES014
      END                                                               FILES015
```

4.0 ANALYSIS PROGRAM FOR THE THREE-DIMENSIONAL BOUNDARY LAYER MODEL

4.1 Introduction

The program is designed to accept a tape written by the three-dimensional boundary layer model in Section 2.0 and to print the simulated results in a variety of formats to permit analysis of the results. The results may be in a time series (t), a map format (x-y), a height space cross section (z-x), and a height time cross section for a horizontal grid point (z-t).

4.2 Card Input

The card input contains one general card and up to four sets of cards. In all cases, a variable indicator is used to define the variable. The variable indicator is listed in Table 1. The analysis sets listed in Table 1 refer to time series (1), map format (2), height space cross sections (3), and height time cross sections (4).

The analysis sets for map format (2) and the height space cross sections (3) have an option to contour print the variable. The value of the contouring parameters is given in Table 2.

TABLE 1
Variable Indicator

Indicator	Valid Analysis Sets	Program Name Section 1.2	Program Name Description
1	4	---	Variables 14-37.
2	4	---	Variables 50-56.
3	1,2,3,4	U	Eastward velocity.
4	↓	V	Northward velocity.
5	↓	T	Temperature.
6	↓	q/s	Humidity/salinity.
7	↓	w	Horizontal velocity.
8	↓	XKU	Vertical momentum coefficient.
9	↓	VVEL	Vertical velocity.
10	↓	RI	Richardson number.
11	↓	DT1	Radiative heating rate.
12	↓	PP1	Pollutant 1.
13	↓	PP2	Pollutant 2.
14	2	RADMX	Artificial heat source.
15	↓	ROW	density of surface.
16	↓	XMQ	Moisture parameter.
17	↓	DEL	Wave steepness.
18		XLAM	Wavelength.
19	1,2	RANS	Downward infrared flux (z_N).
20	↓	RABNS	Upward infrared flux (z_N).
21	↓	RABS	Upward infrared flux (z=0).
22	↓	RAA	Downward infrared flux (z=0).
23	↓	CRNS	Downward solar flux (z_N).
24	↓	CRS	Downward solar flux (z=0).
25	↓	TOUPRA	Upward solar flux (z_N).
26	↓	SRS	Albedo.
27	↓	TAWAS	Eddy stress (z_N).
28	↓	TAWIS	Eddy stress (z=0).
29	↓	TAWWS	Eddy stress (z_1).
30	↓	HAS	Eddy heat flux to atmos.(z_N).
31	↓	HAIS	Eddy heat flux to atmos.(z=0).
32	↓	HSIS	Eddy heat flux to subsfc.(z=0).

Table 1 (Continued). Variable Indicator

Indicator	Valid Analysis Sets	Program Name Section 1,2	Program Name Description
33	1,2	HSS	Eddy heat flux to subsurface (z_1).
34		CES	Eddy water vapor flux into atmosphere (z_N).
35		CEAS	Eddy water vapor flux into atmosphere (z=0).
36		CFNS	Eddy salinity flux into ocean (z=0).
37		CF	Eddy salinity flux to bottom (z_1).
38		H3S	Height of characteristic wave.
39		ETA2	Departure of water surface from mean.
40		XETA2	$\partial\eta/\partial x$.
41		YETA2	$\partial\eta/\partial y$.
42		HEIGHT	See card 20(a), Cols. 25-36 for model input of Section .
43-49			Not used.
50		RSUM(1)	Time sum for latent heat flux.
51		2	Time sum for atmos. heat flux.
52		3	Time sum for subsurface heat flux.
53		4	Time sum for precip. heat flux.
54		5	Time sum for solar heat flux.
55		6	Time sum for infrared heat flux.
56		7	Time sum for artificial heat flux.
57		8	Time sum for outgoing infrared heat flux.
58		9	Net solar (z=N).
59		10	Net TR (z=N).

TABLE 2

Contouring Parameter

IANA = 0 No grid analysis
1 Prints and contours
2 Contours
3 Prints

Input Deck Setup for Analysis and Gridprint Program

Card Type	Format	Columns	Symbol Integers	Program Designates
0	14I5	4-5	NTPLØ	Number of cards for time series plots ($\leq$ 30)(n.d.).
		9-10	NXYPLØ	Number of cards for maps in X-Y plots ($\leq$ 20)(n.d.).
		14-15	NZXPLØ	Number of cards for height cross sections ($\leq$ 10)(n.d.).
		19-20	NZTPLØ	Number of cards for time cross sections ($\leq$ 10)(n.d.). If "-1", print out entire simulation run and no cards are needed.
		25	MØRE	"0" last data set. "1" more data sets.
		29-30	ITAPE	Tape unit for analysis tape.
		34-35	I95	Tape unit from prediction run. If "0", only analysis tape is used.
		39-40	NFAREN	Temperature units indicator. "0" Centigrade, "1" Fahrenheit, "2" Absolute.

Include only sets that are desired. The number of cards in each set below is shown on Card type 0.

Card Type	Format	Columns	Symbol Integers	Program Designates
A	14I5	4-5	IXTRA	Total number of print time steps.
		9-10 ⋮ 69-70	MARAY(I)	A(1) is punched for each printed time step (I=1,IXTRA).

Analysis Set 1 will produce: Time series, plots.

Card Type	Format	Columns	Symbol Integers	Program Designates
1	14I5	4-5	IVAR	Variable indicator from Table 1.
		9-10	IZPLØT	Height level to be plotted (1 < IZPLØT < NX+1)*.

---

* NX is defined in Section 1.2.

		14-15	ISTAT	Grid point index for horizontal grid points to be plotted. The horizontal grid points are defined from Figure 2 as 1 = point (1,1), 2 = point (1,2), etc.

Analysis Set 2 will produce maps in x,y format.

2	14I5	4-5	IVAR	Variable indicator from Table 1.
		9-10	IZPLØT	Height level to be plotted ($1 < \text{IZPLØT} < NX+1$)*.
		14-15	IANA	Contouring parameter, Table 2.
		19-20	ITISTP	Time step index (≤ 20) (not the time step).

Analysis Set 3 will produce: Height-space cross section.

3	14I5	4-5	IVAR	Variable indicator from Table 1.
		9-10	IANA	Contouring parameter, Table 2.
		14-15	ITISTP	Time step index (≤ 20) (not the time step).
		19-20	I1	Number of horizontal grid points in cross section.
		24-25 29-30 ⋮ 69-70	ISTOUT(I)	Horizontal grid point indices of points in cross section (I=1,I1).

Analysis Set 4 will produce: Height-time cross sections.

4	14I5	4-5	IZTSTA	Horizontal grid point index.
		9-10	I2	Number of variable indicators.
		14-15	IVAR	Variable indicators (1 to I2) from Table 1 ($1 \leq \text{IVAR} \leq 13$).

---

* NX is defined in Section 1.2.

4.3 FORTRAN Listing for ANALYSIS Program

```
C     ANALYSIS PROGRAM
      COMMON NSTOUT(10),ISTR,IMAX,JMAX,IGRID,IX,DT,REALT,NREDS
      COMMON ITIMES(20)
      COMMON IVAR(30,3),IZPLOT(30,2),ITISTP(20,2),ISTOUT(20,10)
      COMMON ISTAT(30),IANA(30,2),COM(18),Z(30),ZA(30),ISET(20)
      COMMON TRANS(30,20),XYPLO(100,20),ZXPLO(20,30,20),AA(600)
     1  ,BA(30,20),IZTSTA(100),NZTVA(100),IZTVA(100,13)
      DIMENSION MAXA(100),MAXX(100),IIVAR(1),IPOL(13),RSUM(15,40)
      DIMENSION VRNM(126)
      EQUIVALENCE (IIVAR(1),IVAR(1,1))
      EQUIVALENCE (MAXA(1),MAXX(1))
      EQUIVALENCE (AA(1),RSUM(1,1))
      DATA IPOL /0,0,2,2,2,2,3,0,3,3,3,3,3/
      DATA VRNM /4HU   ,4H    ,4HV   ,4H    ,4HT   ,4H    ,4HQ   ,4H
     1   ,4HWSS ,4H    ,4HXKU ,4H    ,4HVVEL,4H    ,4HRI  ,4H    ,4HDT1
     2   ,4H    ,4HPP1 ,4H    ,4HPP2 ,4H    ,4HRADM,4HX   ,4HROW ,4H
     3   ,4HXMQ ,4H    ,4HDEL ,4H    ,4HXLAM,4H    ,4HRAN ,4H    ,4HRABN
     4   ,4H    ,4HRAB ,4H    ,4HRAA ,4H    ,4HCRN ,4H    ,4HCRS ,4H
     5   ,4HTOUP,4HRA  ,4HSRS ,4H    ,4HTAWA,4H    ,4HTAWI,4H    ,4HTAWW
     6   ,4H    ,4HHA  ,4H    ,4HHAI ,4H    ,4HHSI ,4H    ,4HHS  ,4H
     7   ,4HCE  ,4H    ,4HCREA,4H    ,4HCF(0,4H)   ,4HCF(1,4H)   ,4HH3
     8   ,4H    ,4H   E,4HTA2 ,4H  XE,4HTA2 ,4H  YE,4HTA2 ,4HHEIG,4HHT
     9   ,4H    ,4H    ,4H    ,4H    ,4H    ,4H    ,4H    ,4H    ,4H
     1   ,4H    ,4H    ,4H    ,4H    ,4H    ,4HLE S,4HUM  ,4HA SU,4HM
     2   ,4HS SU,4HM   ,4HP SU,4HM   ,4HR(1-,4HA)  ,4HRA S,4HUM  ,4HMAN
     3   ,4HSUM ,4HTG**,4H4   ,4HNET ,4HSOL ,4HNET ,4HIR S,4H    ,4H
     4   ,4H    ,4H    ,4H    ,4H    ,4H    ,4H    ,4H    ,4H    /
C     READ NECESSARY TAPE INFORMATION
   11 READ 1, NTPLO,NXYPLO,NZXPLO,NZTPLO,MORE,ITAPE,I95,NFAREN
      PRINT1, NTPLO,NXYPLO,NZXPLO,NZTPLO,MORE,ITAPE ,I95,NFAREN
    1 FORMAT(14I5)
      IF (I95.GT.0) CALL TAPCHG (I95,ITAPE)
      DO 919 I=1,616
  919 NSTOUT(I) = 0
      IF( NTPLO )22,22,20
C     TIME SERIES
   20 DO 21K=1,NTPLO
      READ 1, IVAR(K,1),IZPLOT(K,1),ISTAT(K)
      PRINT1, IVAR(K,1),IZPLOT(K,1),ISTAT(K)
   21 CONTINUE
   22 IF(NXYPLO)25,25,23
C     X-Y PLOTS
   23 DO 24K=1,NXYPLO
      READ 1, IVAR(K,2),IZPLOT(K,2),IANA(K,1),ITISTP(K,1)
      PRINT1, IVAR(K,2),IZPLOT(K,2),IANA(K,1),ITISTP(K,1)
   24 CONTINUE
   25 IF(NZXPLO)29,29,26
   26 DO 27K=1,NZXPLO
      READ 1, IVAR(K,3),IANA(K,2),ITISTP(K,2),I1,(ISTOUT(IK,K),IK=1,I1)
      PRINT1, IVAR(K,3),IANA(K,2),ITISTP(K,2),I1,(ISTOUT(IK,K),IK=1,I1)
      NSTOUT(K) = I1
   27 CONTINUE
   29 CONTINUE
      IF (NZTPLO.LE.0) GO TO 420
      DO 419 J=1,NZTPLO
      READ 1,IZTSTA(J),I1,(IZTVA(J,I),I=1,I1)
      PRINT1,IZTSTA(J),I1,(IZTVA(J,I),I=1,I1)
  419 NZTVA(J) = I1
  420 IF(NZTPLO.EQ.-1) GO TO 421
      IF ((NTPLO+NXYPLO+NZXPLO+NZTPLO).LE.0) GO TO 1999
C-READ RECORD (1) AND SET UP CONSTANTS
  421 KK=1
      READ (ITAPE) AA
 2222 FORMAT (1X9E13.5)
      DO 18I=1,18
   18 COM(I) = AA(I)
      IMAX = AA(52)
      JMAX = AA(53)
      IGRID = IMAX * JMAX
      IX = AA(55)
      NP1 = AA(21)
      NM1 = NP1-2
      DT = AA(54)
      DT = DT/60.
      ISTR = AA(56)
      DO 68I=1,20
   68 ITIMES(I) = AA(I+62)
      XD = AA(600)
      NRECS = AA(20)
      DO 51I=1,30
   51 Z(I) = AA(I+21)        /100.
      L = 0
      NX = NP1-1
      DO 32 I=1,NX
      T1 = (Z(I)+Z(I+1))/2.
      IF (I.EQ.IX) GO TO 32
      L = L+1
      ZA(L) = T1
   32 CONTINUE
      KOUNT = 1
      DO 60KK=1,IGRID
      KL = ((IGRID-KK)/IMAX) * IMAX+1+MOD(KK-1,IMAX)
      DO 63 II=1,2
      IF(KOUNT.EQ.1) GO TO 64
      READ (ITAPE,END=72 ) AA
   64 IF(II.EQ.2)GO TO 62
      IJ = 14
      IE = 42
      IS = 82
      KOUNT = 2
      GO TO 61
   62 IJ = 50
      IE = 59
      IS = 0
 1000 FORMAT ('1RADIATION FLUXES FOR STATION',I5,' FOR',18A4/'  TIME',20
     1X,'DT=',F8.3  /'  STEP       RA(Z=N)       RB(Z=N)       RB(Z=0)
     2 RA(Z=0)      SOLAR(Z=N)      SOLAR(Z=0)      SOLAR UP       ALBEDO')
   61 IF(NZTPLO.EQ.-1) GO TO 1061
      IF(NZTPLO.LE.0)  GO TO 161
      DO 162 MI=1,NZTPLO
      IF(IZTSTA(MI).NE.KK) GO TO 162
      MK = NZTVA(MI)
      DO1162 MJ=1,MK
      IF(IZTVA(MI,MJ).EQ.II) GO TO 1061
 1162 CONTINUE
  162 CONTINUE
      GO TO 161
 1061 GO TO (163,164),II
  163 PRINT 1000, KK,COM,DT
      DO 1001I=1,ISTR
      ISTEP = ITIMES(I)
      PRINT 1002,     ISTEP,AA(I+82),AA(I+102),AA(I+122),AA(I+142),
     1 AA(I+162),AA(I+182),AA(I+202),AA(I+222)
 1001 CONTINUE
      PRINT 1003
 1003 FORMAT(//30X,45HUPPER AND LOWER BOUNDARY AND INTERFACE FLUXES//
     111X,28H(------(DYNES/CM**2)-------),4X,36H(-------------(MLY/SEC)-
     2------------),4X,36H(MGM/SEC CM**2)      (MUGM/SEC CM**2),2X,8H(--CM
     3--)/6H  TIME,6X,6HTAW(N),7X,3HTAW,4X,6HTAW(1),6X,4HH(N),9X,1HH,9X,
     41HH,6X,4HH(1),6X,4HE(N),9X,1HE,9X,1HF,6X,4HF(1),4X,6HH(1/3)/6H  ST
     5EP,19X,3HZ=0,26X,4HZ=+0,6X,4HZ=-0,26X,4HZ=+0,6X,4HZ=-0//)
       DO 1004I=1,ISTR
       ISTEP = ITIMES(I)
       PRINT 1005,   ISTEP,AA(I+242),AA(I+262),AA(I+282),AA(I+302),
     1AA(I+322),AA(I+342),AA(I+362),AA(I+382),AA(I+402),AA(I+422),
     2AA(I+442),AA(I+462)
 1004 CONTINUE
      PRINT 1113
 1113 FORMAT(//30X,'ETA2      XETA2      YETA2'/6H  TIME,6X,6H ETA2 ,
     1 7X,5HXETA2,4X,5HYETA2,4X,5H   H3//)
      DO 1114I=1,ISTR
      ISTEP = ITIMES(I)
      PRINT 1005,  ISTEP,AA(I+482),AA(I+502),AA(I+522)
     1    ,AA(I+462)
 1114 CONTINUE
 1005 FORMAT (1X,I4,4X,3F10.4,4F10.3,4F10.4,F8.0)
 1002 FORMAT (1X,I4,8E14.5)
      GO TO 161
  164 PRINT 1006,KK,COM
 1006 FORMAT ('1RSUMS FOR STATION',I5,' FOR',18A4/6H  TIME/'  STEP
     1LE                A                 S                P              R(1-A)
     2    RA               MAN              TG**4')
      DO 1007I=1,ISTR
      PRINT 1002, ITIMES(I), (RSUM(K,I),K=1,8)
 1007 CONTINUE
      PRINT 1008
 1008 FORMAT (6X,'NET SOLAR(Z=N) NET IR(Z=N)')
      DO 1009 I=1,ISTR
 1009 PRINT 1002,ITIMES(I),(RSUM(K,I),K=9,10)
C  FOR N. LORD
 1301 FORMAT('DAILY SUMS STATION',I5)
      KI = 1440./DT
      K1 = 0
      DO 1310 I=1,ISTR
      IF(ITIMES(I).LT.KI) GO TO 1310
      K1 = K1 + 1
      DO 1309 K=1,10
 1309 BA(I,K) = RSUM(K,I) - RSUM(K,K1)
```

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      PRINT 1308,ITIMES(I),(BA(I,K),K=1,5)
      PRINT 1308,KK        ,(BA(I,K),K=6,10)
 1310 CONTINUE
 1308 FORMAT(1X,I5,5E12.4)
      PRINT 1301,KK
  161 DO 40 ICALL=IJ,IE
      IF (II.EQ.1) MA = (ICALL-IJ-5)*20+IS
      IF (II.EQ.2)MA=ICALL-IJ+1
      IF (ICALL.LT.19) MA = ICALL+144
      DO 40 K=1,60
      IF(IIVAR(K).NE.ICALL)GO TO 40
      IF(K.GT.30) GO TO 33
C-SET UP TIME SERIES
      IF(ISTAT(K).NE.KK)GO TO 40
      DO 31 I=1,ISTR
      MM = MA + I
      IF (II.EQ.2) MM = MA+15*I
   31 TRANS(I,K) = AA(MM)
      GO TO 40
C-SET UP XYPLOT FOR VARIABLES  19 NO (Z) DEPENDANCE
   33 I1 = MA + ITISTP(K-30,1)
      IF (II.EQ.2) I1 = MA+(ITISTP(K-30,1))*15-15
      IF(ICALL.EQ.42) I1 = 599
      XYPLO(KL,K-30) = AA(I1)
   40 CONTINUE
   63 CONTINUE
C-SET UP STORE FROM VARIABLES 3-13
      DO 70 ICALL=3,NRECS
C-READ RECORD INTO BA(30,20)
      READ (ITAPE,END=73) BA
      IF(ICALL.EQ.5.OR.ICALL.EQ.7) GO TO 1446
      GO TO 1449
 1446 DO 1450 I=1,NP1
      DO 1450 J=1,ISTR
      IF(ICALL.EQ.5) BA(I,J) = BA(I,J) - 273.16
      IF(ICALL.EQ.7) BA(I,J) = BA(I,J) * .0194254
 1450 CONTINUE
 1449 CONTINUE
      IF (NZTPLO.EQ.-1) GO TO 449
      IF (NZTPLO.LE.0) GO TO 451
      DO 445 I=1,NZTPLO
      IF (IZTSTA(I).NE.KK) GO TO 445
      I1 = NZTVA(I)
      DO 444 J=1,I1
      IF (IZTVA(I,J).EQ.ICALL) GO TO 449
  444 CONTINUE
  445 CONTINUE
      GO TO 451
  449 I2 = ICALL*2-5
      I3 = I2+1
      PRINT 448,VRNM(I2),VRNM(I3),COM,KK,DT
      IF (ICALL.EQ. 8.OR.ICALL.EQ.10) GO TO 1448
      CALL PRT (NP1,IPOL(ICALL),ISTR,Z,BA,ITIMES)
      GO TO 451
 1448 CALL PRT (NM1,IPOL(ICALL),ISTR,ZA,BA,ITIMES)
  451 CONTINUE
  448 FORMAT ( '1VARIABLE= ',2A4,' FOR ',18A4,' STATION=',I5,' DT=',F5.2
     1 ///' HEIGHT',4X,13(5X4HTIME)/4X'IN',5X,13(5X'STEP'))
      IF(NTPLO.LE.0) GO TO 45
C-TIME SERIES
      DO 44K=1,NTPLO
      IF(IVAR(K,1).NE.ICALL) GO TO 44
      IF(ISTAT(K).NE.KK) GO TO 44
      I1 = IZPLOT(K,1)
      DO 42 I=1,ISTR
   42 TRANS(I,K) = BA(I1,I)
   44 CONTINUE
C-SET UP  X,Y PLOT
   45 IF(NXYPLO.LE.0) GO TO 52
      DO 50 K=1,NXYPLO
      IF(IVAR(K,2).NE.ICALL)GO TO 50
      I1 = IZPLOT(K,2)
      I2 = ITISTP(K,1)
      XYPLO(KL,K) = BA(I1,I2)
   50 CONTINUE
C-SET UP  Z,X PLOT
   52 IF (NZXPLO.LE.0) GO TO 70
      DO 56 K=1,NZXPLO
      IF(IVAR(K,3).NE.ICALL) GO TO 56
      IJ = NSTOUT(K)
      DO 53 I=1,IJ
      IF(ISTOUT(I,K).NE.KK) GO TO 53
      IT = I
   54 I1 = ITISTP(K,2)
      DO 55 M=1,NP1
      ZXPLO(IT,M,K) = BA(M,I1)
   55 CONTINUE
   53 CONTINUE
   56 CONTINUE
   70 CONTINUE
   60 CONTINUE
      REWIND ITAPE
  301 NX = NP1-1
      IF(NTPLO.LE.0) GO TO 311
      DO 110K=1,NTPLO
  110 CALL PLOT(TRANS(1,K),VRNM,K,NFAREN)
  311 IF(NXYPLO.LE.0) GO TO 131
      DO 310I=1,JMAX
      MAXX(I) = 1
  310 MAXX(I+JMAX) = IMAX
      DO 130K=1,NXYPLO
      I1 = 1
      IJ = MIN0(IMAX,11  )
      IPLOT1 = ITISTP(K,1)
      REALT = DT * ITIMES(IPLOT1)
      REALT = REALT/60.
      IZ = IZPLOT(K,2)
  111 PRINT 209, (COM(I),I=1,18)
  209 FORMAT(1H1,18A4)
      IPLOT2 = 2*IVAR(K,2) -5
      PRINT 212, VRNM( IPLOT2),VRNM(IPLOT2+1),ITIMES(IPLOT1),DT,REALT,
     1  Z(IZ),XD
  212 FORMAT('      X-Y PLOT FOR VARIABLE ',2A4/' TIME STEP=',I5,'  DT=',
     1F6.2,'  REAL TIME=',F6.2,' HOURS  HEIGHT=',F8.1,' M X DIST=',F8.0)
      DO 112I=I1,IJ
  112 ISET(I) = I
      PRINT 213, (ISET(I),I=I1,IJ)
  213 FORMAT(1H0, I15,10I10)
      I2 = I1
      I3 = IJ
      DO 115 JJ=1,JMAX
      J = JMAX-JJ+1
      I2 = (J-1)*IMAX+I1
      I3 = I2+IJ -1
      PRINT 514, J,(XYPLO(M,K),M=I2,I3)
  514 FORMAT (1H0,I5,11F10.3)
  115 CONTINUE
      IF(IMAX.LE.IJ) GO TO 125
      I1 = I1 + 11
      IJ = MIN0(IJ+11,IMAX)
      GO TO 111
  125 CONTINUE
      I1 = IANA(K,1)-2
      IF(IANA(K,1).GE.1) CALL GRIDPR(XYPLO(1,K),IMAX,JMAX,K,1,I1,MAXA,
     1  VRNM(IPLOT2),IMAX,JMAX)
  130 CONTINUE
C     SET UP FOR  Z,X PLOT-PRINT
  131 CONTINUE
      IF (NZXPLO.LE.0)  GO TO 1999
      DO 200 K=1,NZXPLO
      DO 308I=1,NP1
      MAXX(I) = 1
  308 MAXX(I+NP1) = NSTOUT(K)
      I2 = 1
      LOOP = 1
      IF(NSTOUT(K).GT.10) LOOP = 2
      DO 180 J=1,LOOP
      PRINT 209, (COM(I),I=1,18)
      IPLOT1 = ITISTP(K,2)
      IPLOT2 = 2*IVAR(K,3) -5
      REALT = DT * ITIMES(IPLOT1)
      REALT = REALT/60.
      PRINT 216, VRNM(IPLOT2),VRNM(IPLOT2+1),ITIMES(IPLOT1),DT,REALT,
     1  IMAX,JMAX,XD
  216 FORMAT ('0  Z-X PLOT FOR VARIABLE ',2A4/' TIME STEP=',I5,' DT=',F6
     1.2,'  REAL TIME =',F6.2,' HOURS  IMAX=',I5,' JMAX=',I5,'  GRID DIS
     2TANCE =',F8.0,'KM'/'0HEIGHT(M)     STATIONS')
      I3 = MIN0(I2+9,NSTOUT(K))
      PRINT 215,(ISTOUT(I,K),I=I2,I3)
  215 FORMAT(1H0,7X10I11)
      DO 170 M1=1,NP1
      M = NP1-M1+1
  170 PRINT 217, Z(M),(ZXPLO(I,M,K),I=I2,I3)
  217 FORMAT(1H0,F7.1,10F11.3)
      I2 = I2 + 10
  180 CONTINUE
      I1 = IANA(K,2)-2
      IF(IANA(K,2).GE.1) CALL GRIDPR(ZXPLO(1,1,K),NSTOUT(K),NP1,K,2,I1,
    1 MAXA,VRNM(IPLOT2),20,30)
  200 CONTINUE
 1999 IF(MORE) 999,999,11
   72 PRINT 333,II,KK
  333 FORMAT ('0END OF FILE AFTER RECORD',I5,' AT STATION',I5)
      GO TO 74
   73 PRINT 333,ICALL,KK
   74 REWIND ITAPE
      GO TO 1999
  999 CALL EXIT
      END
      SUBROUTINE GRIDPR(A,MAXX,MAXJ,KIN,IXOXZ,ICTP,MAXA,VARNUM,
     1  IEX,JEX)
C  *** IF MAXI LT 0, SPACING IS 1 INCH, POSITIVE .5 INCH
C  *** IF KA  NEG,0, DATA STARTS AT 1,1 OF A,BUT IS ACTUALLY
C  *** ON GRID AT KA,KB (WRT 0,0)
C  *** KA GT 0 INDICATES SUBSET OF ARRAY WRT 0,0
      COMMON NSTOUT(10),ISTR,IMAX,JMAX,IGRID,IX,DT,REALT,NRECS
      COMMON ITIMES(20)
      COMMON IVAR(30,3),IZPLOT(30,2),ITISTP(20,2),ISTOUT(20,10)
      COMMON ISTAT(30),IANA(30,2),COM(18),Z(30),ZA(30),ISET(20)
      DIMENSION BAND(20),SCALES(4),VARNUM(1)
      DIMENSION A(IEX,JEX  ),PLINE(115),LINE(115)
      EQUIVALENCE (PLINE(1),LINE(1))
      DIMENSION MAXA(1)
      DATA BAND/4H1   ,4H    ,4H2   ,4H    ,4H3   ,4H    ,4H4   ,4H    ,
     1   4H5   ,4H    ,4H6   ,4H    ,4H7   ,4H    ,4H8   ,4H    ,4H9   ,
     2   4H    ,4H 0  ,4H    /
      KA = 0
      KB = 0
      MAXI = MAXX
      SCALES(2) = 1.
      SCALES(1) = 0.
      IF (ICTP.EQ.0) SCALES(2) = 0.
C  ABOVE IS JUST CONTOURS,BELOW IS NO CONTOURS
      IF (ICTP.EQ.1) SCALES(4) = 0.
      IF (ICTP.GT.0) GO TO 810
      ROW = A(1,1)
      YY =  ROW
      DO 800 I=1,MAXX
      DO 800 J=1,MAXJ
      IF (A(I,J).GT.ROW)  ROW = A(I,J)
      IF (A(I,J).LT.YY)   YY  = A(I,J)
  800 CONTINUE
      XY = (ROW-YY)/18.
      IE = YY/XY
      SCALES(3) = IE*XY
      SCALES(4) = XY
  810 IF (MAXI.GT.10.OR.MAXJ.GT.20) GO TO 6
    5 NINT=6
      IP6 = -1
      M=10
      IE = 10
      CT=.1
      GO TO 7
    6 NINT=3
      IP6 =  1
      M=5
      CT=.2
      IE = 20
    7 KAA = -(KA+1)
      ILEFT = KA+1
      KBB = KB+MAXJ
      KBA = KBB+1
   13 IF(MAXI-IE) 14,14,15
   14 ILOOP = 1
      IRIGHT = ILEFT+MAXI-1
      GO TO 16
   15 ILOOP = (MAXI-1)/IE+1
      IRIGHT=ILEFT+IE-1
   16 BLANK=BAND(20)
      I1 = ITISTP(KIN,IXOXZ)
      ITM = ITIMES(I1)
      DO 355 IJK=1,ILOOP
   40 PRINT 1005,COM,VARNUM(1),VARNUM(2),ITM,DT,REALT
 1005 FORMAT ('1RESULTS OF ',18A4,' FOR ',2A4/' AT TIME STEP',I5,' DT=',
     1F5.1,' MINUTES (OR REAL TIME OF ',F10.2,' HOURS)')
      IZ = IZPLOT(KIN,2)
      IF (IXOXZ.EQ.1) PRINT 1008,Z(IZ)
 1008 FORMAT(' HEIGHT IS ',F10.1,' METERS' )
      IF (IXOXZ.EQ.2) PRINT 1007
 1007 FORMAT ('0   STATIONS')
C     COMPUTE COLUMN INDICES AND OUTPUT A PAGE HEADING
   60 DO 70 I=ILEFT,IRIGHT
      PLINE(I) = I
      IF(IXOXZ.EQ.2) PLINE(I) = ISTOUT(I,KIN)
   70 CONTINUE
C   CHANGE PREVIOUS DO LOOP TO ALTER COLUMN HEADING
   81 PRINT 1004, SCALES(2),SCALES(1),SCALES(3),SCALES(4),BAND
      IF (IP6) 84,83,83
   84 PRINT  905, (PLINE(I),I=ILEFT,IRIGHT)
  905 FORMAT (1XF16.0,10F10.0)
      GO TO 90
   83 PRINT 1006, (PLINE(I),I=ILEFT,IRIGHT)
 1006 FORMAT (1H ,F11.0,20F5.0)
C     DO-LOOP TO GENERATE OUTPUT FOR EACH ROW ON A PAGE
   90 DO 350 JREV=1,MAXJ
  100 J = KBA-JREV
  110 JINT= KBB-JREV+1
      ROW = JINT
      IF (IXOXZ.EQ.2) ROW = Z(JINT)
C   CHANGE ROW FOR ALTERING ROW IDENTIFER
C     DO-LOOP FOR THE NUMBER OF PRINT LINES PER 1/2 INCH ON THE PAGE
  120 DO 340 JINT=1,NINT
C     INITIALIZE A BLANK INTERPOLATED PRINT LINE
  130 DO 140 IPL=1,115
  140 PLINE(IPL) = BLANK
C     CONDITIONS FOR VALUE-PRINTING AND CONTOUR BANDING
  160 IF (JINT-NINT) 162,161,162
  162 IF (JREV-1) 170,291,170
  161 IF(SCALES(2))310,170,310
  170 IF(SCALES(4))180,280,180
  180 YY=1.-FLOAT(JINT)/FLOAT(NINT)
  185 IP1=-M
C     DO-LOOPS FOR M PRINT CHARACTERS FOR 1/2 INCH HORIZONTALLY
  190 DO 270 IINT=1,M
  191 IP1=IP1+1
  192 IPL=IP1
  200 XY=CT*FLOAT(IINT)
  210 DO 270 I=ILEFT,IRIGHT
  215 IPL= IPL+M
      IF (IJK-1) 220,220,46
   46 IF (MAXA(J+MAXJ)-I) 270,231,231
   47 IF (MAXA(J)-I) 231,270,270
  220 IF(I-ILEFT) 47,270,47
C       GENERATING CONTOUR BANDS
  231 IBAND=1.+(A(I-1,J  )-SCALES(3)+XY*(A(I,J  )-A(I-1,J  )) +YY*
     X(A(I-1,J+1  )-A(I-1,J  )) +XY*YY*(A(I-1,J  )+A(I,J+1  )-A(I-1,J+1
     X )-A(I,J  ))) /SCALES(4)
  240 IF(IBAND)270,270,250
  250 IBAND= MOD(IBAND-1,20)+1
  260 PLINE(IPL)= BAND(IBAND)
  270 CONTINUE
C     WRITE BLANK OR BANDED LINES
  280 IF(JINT-NINT)290,281,340
  281 PRINT 1001,  ROW,PLINE
 1001 FORMAT (1XF5.0,125A1)
      GO TO 340
  290 IF(IP6)     291,295,295
  291 PRINT 293,  PLINE
  293 FORMAT (6X125A1)
      GO TO 340
  295 PRINT 1002,  PLINE
 1002 FORMAT (6X125A1)
  300 GO TO 340
C     WRITE GRIDPOINT VALUES
  310 DO 320 I=ILEFT,IRIGHT
      IF (A(I,J) .EQ.0.)  A(I,J)=1.E-15
      T1 = ABS(A(I,J))/A(I,J)*.5
  321 LINE(I) = SCALES(2)*A(I,J)+SCALES(1)+T1
  320 CONTINUE
  330 IF (IP6) 329,331,331
  329 PRINT 328,    ROW,(LINE(I),I= ILEFT,IRIGHT)
  328 FORMAT (1XF5.0,1H*I9,10(1H*I9),1H*)
      GO TO 340
  331 PRINT 1003,    ROW,(LINE(I),I=ILEFT,IRIGHT)
 1003 FORMAT(1XF5.0,1H*,24(I4,1H*))
  340 CONTINUE
  350 CONTINUE
      ILEFT = IRIGHT+1
      IP1 = IE+IRIGHT
      IPL = KA+MAXI
      IRIGHT = MIN0(IP1,IPL)
  355 CONTINUE
  360 RETURN
 1004 FORMAT(17H NOS. TRANSFORMED1PE10.2,4H *X+E10.3,2X,13HCONTOUR BASE=
     11PE10.3,6H, INT=E10.3,7H BANDS=A1,19(1H,A1)//)
      END
      SUBROUTINE STOR (ISTR)                                            001
      DOUBLE PRECISION DT1,PP12,PP22,TT2,U2,V2,W2,YY                    002
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, TAPCHG1
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE TAPCHG2
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2,VVEL(30)
      COMMON XKU(30),            SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2,RADMX2,RADMX1
      COMMON Z(30),ZA(30),DZ(30),DS(30),DUMMY(135),COM(18),VARIN(30)
     1   ,NCS,JMAX,IMAX,NX,NP1,IX,DT,ITIMES(20),IM1,ABC,IP1,NM1,IP2     008
     2   ,IGRID,NRECD,ITAPE                                             009
      COMMON AB(600),U2S(30,20),V2S(30,20),TT2S(30,20),W2S(30,20)       010
     1 ,WSS(30,20),XKUS(30,20),XKTS(30,20),RIS(30,20),DT1S(30,20)       011
     2   ,PP1S(30,20),PP2S(30,20),RSUMS(15,40)                          012
      COMMON IUAR97                                                     013
      DIMENSION PP12(30),PP22(30),TT2(30),U2(30),V2(30),W2(30)          014
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,3),TT2(1))      015
     1   ,(YY(1,4),W2(1)),(YY(1,5),PP12(1)),(YY(1,6),PP22(1))           016
      IF(ISTR.EQ.1)PRINT 2, AB(20)                                      017
    2 FORMAT (1XE14.5,' AB')                                            018
      IF (ISTR.GT.1) GO TO 89                                           019
      AB(57) = IGOGO                                                    S020
      AB(58) = RADMX                                                    S021
      AB(59) = ROW                                                      022
      AB(60) = XMQ                                                      023
      AB(61) = DEL                                                      024
      AB(62) = XLAM                                                     025
      AB(599) = HEIGHT/ 100.
   89 I = ISTR                                                          026
      AB(I+82) = RANS                                                   027
      AB(I+102) = RABNS                                                 028
      AB(I+122) = RABS                                                  029
      AB(I+142) = RAA * 1.E3                                            030
      AB(I+162) = CRNS                                                  031
      AB(I+182) = CRS * 1.E3                                            032
      AB(I+202) = TOUPRA                                                033
      AB(I+222) = SRS                                                   034
      AB(I+242) = .001 *RSUM(15) * CSOUT(2)                             035
      AB(I+282) = ROW*XKU(1)*CSOUT(1)                                   036
      AB(I+302) =-.239*RSUM(15)*((TT2(NP1)-TT2(NX))/DZ(NX)+.98E-4)      037
      AB(I+362) = ROW*CW*RSUM(14)*(TT2(2)-TT2(1))/DZ(1)*1.E3            038
      AB(I+402) = CE * 1.E3                                             039
      AB(I+382) =-     RSUM(15)*(W2(NP1)-W2(NX))/DZ(NX)                 040
      AB(I+422) = CF * 1.E3                                             041
      AB(I+442) = ((ROW*RSUM(14)*(W2(2)-W2(1))) / DZ(1))*1.E3
    5 AB(I+262) = .001 * XKU(IP1)*(WS(IP1+1)-WS(IP1))/DZ(IP1)           043
      AB(I+322) = HAI * 1.E3                                            044
      AB(I+342) = HSI * 1.E3                                            045
   15 AB(I+462) = H3                                                    046
      AB(I+482) = ETA2
      AB(I+502) = XETA2 *1.E5
      AB(I+522) = YETA2 * 1.E5
      AB(I+542) = SLOPX
      AB(I+562) = SLOPY
      DO 20K=1,NP1                                                      047
      U2S(K,ISTR) = U2(K)                                               048
      V2S(K,ISTR) = V2(K)                                               049
      TT2S(K,ISTR) = TT2(K)
      W2S(K,ISTR) = W2(K)
      WSS(K,ISTR) = WS(K)
   20 CONTINUE
      DO 25K=1,IM1
      XKUS(K,ISTR) = XKU(K)
      XKTS(K,ISTR) = VVEL(K)
      RIS(K,ISTR) = RI(K)
   25 CONTINUE
      DO 30K=IX,NM1
      XKUS(K,ISTR) = XKU(K+1)
      XKTS(K,ISTR) = VVEL(K)
      RIS(K,ISTR) = RI(K+1)
   30 CONTINUE
      XKTS(NX,ISTR) = VVEL(NX)
      XKTS(NP1,ISTR) = VVEL(NP1)
      DO 40K=1,NP1
      DT1S(K,ISTR) = DT1(K)*86400.
      PP1S(K,ISTR) = PP12(K) / 4.E4
      PP2S(K,ISTR) = PP22(K) / 4.E4
   40 CONTINUE
      DO 12K=1,15
   12 RSUMS(K,ISTR) = RSUM(K)
      RETURN
      END
      SUBROUTINE PLOT(TRANS,VARN,KIN,NFAREN)
      COMMON NSTOUT(10),ISTR,IMAX,JMAX,IGRID,IX,DT,REALT,NRECS
      COMMON ITIMES(20)
      COMMON IVAR(30,3),IZPLOT(30,2),ITISTP(20,2),ISTOUT(20,10)
      COMMON ISTAT(30),IANA(30,2),COM(18),Z(30),ZA(30),ISET(20)
      DIMENSION XPLOT(51,20)
      DIMENSION TRANS (1), VARN(1),RANGE(51)
      DIMENSION RANGF(51)
      DATA BLNK/4H    /
      DATA ASTRIK/4H   */
      DATA ZERO/4H   0/
      DATA TEMPF/4HT   /
   18 XSUM = 0.
C     FIND RANGE OF MEAN FOR SELECTED PARAMETER
      XMAX = TRANS(1)
      XMIN = TRANS(1)
      DO 73NFAR=1,51
   73 RANGF(NFAR) = BLNK
      DO 74 K = 1,ISTR
      IF(TRANS(K).GT.XMAX) XMAX = TRANS(K)
      IF(TRANS(K).LT.XMIN) XMIN = TRANS(K)
      XSUM = TRANS(K) + XSUM
   74 CONTINUE
 1000 XMEAN = XSUM/ISTR
  188 KOUNT = 1
      XINCR = 2.*XSUM/(ISTR*25.)
      XSUM = 0.
      T2 = 25.
 1001 TOP = XSUM + XINCR * T2
      RANGE(1) = TOP
      DO910 M=2,51
      T1 = M-1
      RANGE(M) = TOP - XINCR * T1
  910 CONTINUE
      IF(KOUNT.EQ.2) GO TO 913
      IF(RANGE(1))911,911,913
  911 DO 912 M=1,51
  912 RANGE(M) = - RANGE(M)
  913 CONTINUE
      DO 9 J=1,ISTR
      DO 9 I=1,51
      XPLOT(I,J) = BLNK
    9 CONTINUE
      DO 14 K=1,ISTR
      IF(TRANS(K).LE.RANGE(1)) GO TO 2222
      XPLOT(1,K) = ZERO
      GO TO 14
 2222 IF(TRANS(K).GE.RANGE(51)) GO TO 2223
      XPLOT(51,K) = ZERO
      GO TO 14
 2223 DO 12 I=1,50
      IF(TRANS(K).LE.RANGE(I).AND.TRANS(K).GT.RANGE(I+1)) GO TO 11
   12 CONTINUE
   11 T3 = (RANGE(I)+RANGE(I+1))/2.
      IF(TRANS(K).LT.T3) GO TO 13
      XPLOT(I,K) = ASTRIK
      GO TO 14
   13 XPLOT(I+1,K) = ASTRIK
   14 CONTINUE
      ISTA = ISTAT(KIN)
      I1 = 2*IVAR(KIN,1)-5
      PRINT 104,VARN(I1),VARN(I1+1),COM
  104 FORMAT ('1TIME SERIES OF ',2A4,' FOR ',18A4)
      I2 = IZPLOT(KIN,1)
      T1 = Z(I2)
      IF (I1.EQ.12.OR.I1.EQ.16) T1= ZA(I2)
      PRINT 700, ISTA,DT,T1,XINCR,XMEAN
  700 FORMAT('   THE FOLLOWING GRAPH IS FROM STATION ',I5,'  TIME STEP I
     1S',F6.1,'  MINUTES,  HEIGHT =',F6.1,' METERS' /    '  WITH RANGE
     2INCREMENT COMPUTED ',E12.6,' AND COMPUTED MEAN OF ',E12.6)
      PRINT 119,(ITIMES(I),I=1,ISTR)
119   FORMAT (' TIME STEP ',20I5)
      IF(VARN(I1).EQ.TEMPF.AND.NFAREN.EQ.1) PRINT 1119
 1119 FORMAT(1H+,110X,'FAHRENHEIT')
      IF(VARN(I1).EQ.TEMPF.AND.NFAREN.EQ.2) PRINT 1120
 1120 FORMAT(1H+,110X,' ABSOLUTE ')
      DO 118 I=1,51
      PRINT 1117, RANGE(I),(XPLOT(I,K),K=1,ISTR)
      IF(VARN(I1).NE.TEMPF) GO TO  118
      IF(NFAREN.EQ.1) RANGF(I) = (9./5.) * RANGE(I) + 32.
      IF(NFAREN.EQ.2) RANGF(I) = RANGE(I) + 273.16
 1118 PRINT 120, RANGF(I)
  120 FORMAT(1H+,110X,F10.4)
  118 CONTINUE
 1117 FORMAT (1XE10.4,20(1XA4))
      KOUNT = KOUNT + 1
      IF(KOUNT.GT.2) GO TO 699
      XINCR = (XMAX-(XMAX+XMIN) / 2.) / 25.
      XSUM = XMAX
      T2 = 0.
      IF (XINCR.GT.0.) GO TO 1001
      PRINT 1
    1 FORMAT (' SECOND GRAPH OMITTED--LINEAR')
  699 RETURN
      END
      SUBROUTINE TAPCHG (I95,ITAPO)
C  PROGRAM TO CHANGE FROM PREDICTION TAPE(MULTI-STATION) TO ANALYSIS TAPE
C  UNIT I95 IS INPUT TAPE
C  UNIT ITAPE/ITAPO IS OUTPUT TAPE
C  UNIT 97 IS DISK UNIT FOR RECORDERING RECORDS
      DOUBLE PRECISION DT1,PP12,PP22,TT2,U2,V2,W2,YY
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, TAPCHG1
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE TAPCHG2
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2,VVEL(30)
      COMMON XKU(30),          SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1    ,XLAM,RSUM(15),B1,B2,RADMX2,RADMX1
      COMMON Z(30),ZA(30),DZ(30),DS(30),DUMMY(135),COM(18),VARIN(30)
     1   ,NCS,JMAX,IMAX,NX,NP1,IX,DT,ITIMES(20),IM1,ABC,IP1,NM1,IP2
     2   ,IGRID,NRECD,ITAPE
      COMMON AB(600),U2S(30,20),V2S(30,20),TT2S(30,20),W2S(30,20)
     1 ,WSS(30,20),XKUS(30,20),XKTS(30,20),RIS(30,20),DT1S(30,20)
     2   ,PP1S(30,20),PP2S(30,20),RSUMS(15,40)
      COMMON IUAR97
      DIMENSION PP12(30),PP22(30),TT2(30),U2(30),V2(30),W2(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,3),TT2(1))
     1   ,(YY(1,4),W2(1)),(YY(1,5),PP12(1)),(YY(1,6),PP22(1))
      DIMENSION MARAY(25)
C   DEFINE FILE 97 (STATIONS*PRINT TIME STEPS,4*NCS,L,IUAR97)
      DEFINE FILE 97(500,2376,L,IUAR97)
      READ  1, IXTRA,(MARAY(I),I=1,IXTRA)
      PRINT 1,IXTRA
C NO. WORDS IN NCS
      NCST = 594
      READ (I95)      (Z(I),I=1,NCST)
      NCS = NCST
      ITAPE = ITAPO
      NCS1 = VARIN(1)
      JMAX = VARIN(2)
      IMAX = VARIN(3)
      ABC  = VARIN(4)
      NP1  = VARIN(5)
      IX   = VARIN(6)
      DT   = VARIN(7)
      DO 703 I=1,20
  703 ITIMES(I) = VARIN(I+7)
      XD = VARIN(28)
      IM1 = IX-1
      IP1 = IX+1
      NM1 = NP1-2
      NX  = NP1-1
      IP2 = IX+2
      IGRID = IMAX*JMAX
      J=0
      DO 704 I=1,IXTRA
  704 J = J+MARAY(I)
      NRECD = J*IGRID
      DO 708 I=1,18
  708 AB(I) = COM(I)
      AB(19) = IGRID
      AB(20) = ABC
      AB(21) = NP1
      DO 709 I=22,51
  709 AB(I) = Z(I-21)
      AB(52) = IMAX
      AB(53) = JMAX
      AB(54) = DT
      AB(55) = IX
      DO 710 I=1,20
  710 AB(I+62) = ITIMES(I)
      AB(600) = XD
      ICOUNT = 0
      PRINT 2,COM
    2 FORMAT (1X,18A4)
      DO 705 J=1,NRECD
      READ (195,END=65) (RI(I),I=1,NCST)
      ICOUNT = ICOUNT+1
      WRITE (97'ICOUNT) (RI(I),I=1,NCST)
  705 CONTINUE
      PRINT 1,NRECD,NCS1,ICOUNT
      DO 64 I=1,500
   64 READ (195,END=67) (RI(J),J=1,NCST)
      PRINT 5
    5 FORMAT ('0END OF FILE NOT REACHED AFTER 500 RECORDS')
      GO TO 68
   65 PRINT 4 , J
    4 FORMAT ('1END OF FILE PREMATURE AT RECORD',I7)
      CALL EXIT
   67 PRINT 6
    6 FORMAT ('0END OF INPUT FILE REACHED')
   68 CALL PRINT (IXTRA,MARAY)
      PRINT 3
    3 FORMAT ('1OUTPUT TAPE WRITTEN')
      RETURN
    1 FORMAT (14I5)
      END
      SUBROUTINE PRINT (IXTRA,MARAY)
      DOUBLE PRECISION DT1,PP12,PP22,TT2,U2,V2,W2,YY
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2,VVEL(30)
      COMMON XKU(30),           SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2,RADMX2,RADMX1
      COMMON Z(30),ZA(30),DZ(30),DS(30),DUMMY(135),COM(18),VARIN(30)
     1  ,NCS,JMAX,IMAX,NX,NP1,IX,DT,ITIMES(20),IM1,ABC,IP1,NM1,IP2
     2  ,IGRID,NRECD,ITAPE
      COMMON AB(600),U2S(30,20),V2S(30,20),TT2S(30,20),W2S(30,20)
     1 ,WSS(30,20),XKUS(30,20),XKTS(30,20),RIS(30,20),DT1S(30,20)
     2  ,PP1S(30,20),PP2S(30,20),RSUMS(15,40)
      COMMON IUAR97
      DIMENSION PP12(30),PP22(30),TT2(30),U2(30),V2(30),W2(30)
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,3),TT2(1))
     1  ,(YY(1,4),W2(1)),(YY(1,5),PP12(1)),(YY(1,6),PP22(1))
      DIMENSION MARAY(25)
      ICOUNT = 1
      DO 95L=1,IGRID
      ISTR = 0
      DO 10 I=1,IXTRA
      MIS = MARAY(I)
      DO 9 J=1,MIS
      ISTR = ISTR+1
      READ (97'ICOUNT) (RI(JJ),JJ=1,NCS)
      ICOUNT = ICOUNT + 1
   41 CALL STOR(ISTR)
    9 CONTINUE
      IF(I.EQ.IXTRA) GO TO 10
      NCSP =  MIS *  (IGRID-L)
      ICOUNT = ICOUNT + NCSP
      NCSP =   (L-1) *  MARAY(I+1)
      ICOUNT = ICOUNT + NCSP
   10 CONTINUE
      AB(56) = ISTR
      WRITE (ITAPE)   AB
      WRITE (ITAPE)   RSUMS
      WRITE (ITAPE)   U2S
      WRITE (ITAPE)   V2S
      WRITE (ITAPE)   TT2S
      WRITE (ITAPE)   W2S
      WRITE (ITAPE)   WSS
      WRITE (ITAPE)   XKUS
      WRITE (ITAPE)   XKTS
      WRITE (ITAPE)   RIS
      WRITE (ITAPE)   DT1S
      IF (ABC.GE.12)  WRITE (ITAPE) PP1S
      IF (ABC.EQ.13)  WRITE (ITAPE) PP2S
      LSKIP =  L *  MARAY(1)
      ICOUNT = LSKIP + 1
   95 CONTINUE
      END FILE ITAPE
      REWIND ITAPE
   99 RETURN
      END
      SUBROUTINE PRT (NN,I1,ISTR,ZP,UX,ISTEP)
      DIMENSION ZP(1),UX(30,20)    ,ISTEP(1)
      IT = I1+1
      IB  = 1
      IE  =  ISTR
      IF (ISTR.GT.12) IE=12
      PRINT 129, (ISTEP(I),I=1,IE)
  110 DO 90 I=1,NN
      NRI = NN-I+1
      GO TO (140,141,142,143),IT
  140 PRINT 130, ZP(NRI),(UX(NRI,J),J=IB,IE)
      GO TO 90
  141 PRINT 131, ZP(NRI),(UX(NRI,J),J=IB,IE)
      GO TO 90
  142 PRINT 132, ZP(NRI),(UX(NRI,J),J=IB,IE)
      GO TO 90
  143 PRINT 133, ZP(NRI),(UX(NRI,J),J=IB,IE)
   90 CONTINUE
      IF(IE.GE.ISTR) GO TO 99
      IB = IE+1
      IE = ISTR
      PRINT 128, (ISTEP(I),I=IB,IE)
      GO TO 110
   99 RETURN
  128 FORMAT ('1PAGE 2',4X,13I9)
  129 FORMAT (7H METERS,4X13I9)
  130 FORMAT (1H0,F7.2,3X,13(1XF8.0))
  131 FORMAT (1H0,F7.2,3X,13(1XF8.1))
  132 FORMAT (1H0,F7.2,3X,13(1XF8.2))
  133 FORMAT (1H0,F7.2,3X,13(1XF8.3))
      RETURN
      END
```